1. Cover Page

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| Type of Report: | White Paper-NEH SCHC Planning Grant |
| Grant Number: | PF-50424-14 |
| Project Title: | Planning a Sustainable Preservation Environment for Arizona State Museum's Anthropological Photographs. |
| Project Director: | Teresa Kathleen Moreno |
| Grantee Institution: | University of Arizona, Arizona State Museum |
| Date Submitted: | February 20, 2019 |

2. Narrative Description

**A. Project Activities**

The Arizona State Museum (ASM) at the University of Arizona (UA) proposed to use this NEH Sustaining Cultural Heritage Collections (SCHC) Planning Grant of $48,962 awarded in 2014 to plan and design a sustainable climate-controlled storage suite for the preservation of the museum's valued anthropological photographic collections. The proposal consisted of a request for $38,962 to support the evaluation and planning process plus an additional $10,000 for use to implement recommendations made by the planning team during the project. Except for a change in the location originally identified for renovation to house the photo collections, and the need for two no-cost extensions to accommodate project personnel and collaborator schedule conflicts, the primary goals of this planning process were carried out and completed as proposed.

The primary goals for the planning process were:

1. To evaluate the physical space and environment where the photo collections are currently stored to develop a plan for renovation and creation of a climate-controlled suite for long-term storage, curation and preservation of the variety of photographic media in the ASM collections.

2. To hire Preservation Environment Specialists from the Image Permanence Institute (IPI) to assist in setting up a new environmental monitoring program that would replace old, outdated and failing mechanical hygrothermographs and provide more detailed data on the museum's current environmental conditions.

3. To collaborate with IPI and University of Arizona Facilities Management (UAFM) Energy Conservation Project Managers to assess the museum's antiquated HVAC system and determine what measures could be taken to improve preservation conditions for the photo collections and improve energy efficiency as possible.

4. To use collected environmental data and the IPI environmental and HVAC assessment to inform the development of a schematic design for renovation with a cost analysis by architects and engineers from GLHN Architects & Engineering, Inc (GLHN). From the outset and in preparation for use in the implementation phase of the project, it was proposed that the schematic design should:
    a. Comply with Section 106 of the National Historic Preservation Act (NHPA), given that ASM Building 26 is listed on the National Register of Historic Places and is part of the historic district of the UA campus.
    b. Include design criteria for a new dedicated air-handling unit (AHU) to control temperature and relative humidity in the photo collection storage suite.
    c. Include a structural evaluation of floor load and preliminary strengthening design to support compact mobile shelving for increased storage capacity.
    d. Provide architectural diagrams of modifications to the space.
    e. Provided specifications for electrical, fire protection and security upgrades as needed.

<u>Project Background</u>

Increased concern for the preservation of ASM's anthropological photographic collections grew after the collections were necessarily relocated on short notice from one of ASM's two historic buildings to the other and it was realized that the conditions in the new storage locations were not conducive to

preservation and posed a threat. Photo Collections Curator, Jannelle Weakly, partnered with Associate Conservator, Teresa Moreno, and together they attended an IPI workshop (funded by NEH) *Sustainable Preservation Practices for Managing Storage Environments* in Chicago in the fall of 2012, which effectively launched this planning process. In winter of 2013, Moreno and Weakly submitted their proposal to NEH for a SCHC Planning Grant and the grant was awarded in fall of 2014.

Summary of Project Activities

The NEH SCHC planning project began October 1, 2014. ASM enlisted the expertise of Preservation Environment Specialists, Jeremy Linden and Christopher Cameron, from IPI to set up a new environmental monitoring program and conduct an on-site evaluation of the existing mechanical system and storage conditions. The intended goal was to collect environmental data for the new areas where the photo collections had been relocated to, and for which there was no previous data. In turn, IPI would use the environmental data to inform their environmental assessment and recommendations on how to make sustainable improvements, both short-term and long-term. NEH funds were used to purchase ten PEM2 environmental data-loggers and a two-year professional level subscription to eClimateNotebook web-based data management software from IPI, and to support the IPI consultation that would occur in phases through the duration of the planning phase.

October 13-14, 2014, Project Directors Moreno and Weakly coordinated the project kick-off meeting with the full planning team. It was held in conjunction with the IPI site visit. Team members included ASM collections and conservation personnel, IPI consultants, UAFM Energy Conservation Project Managers Thomas Webb and Joe Thomas, GLHN Mechanical Engineer Patrick O'Brien (assigned to the project by GLHN Principals), and UA Professor and representative from the UA Historic Preservation Advisory Committee R. Brooks Jeffery. Moreno and Weakly provided a summary of the goals for the project and outlined the steps needed to achieve the goals. IPI Preservation Environment Specialists provided an explanation of their role in helping museums create sustainable preservation environments for collections. Team members toured the facility to familiarize or re-familiarize themselves with the current collections storage areas and mechanical systems. The discussions that ensued were highly productive and steered subsequent planning. The importance of being able to bring IPI professionals into the conversation with UAFM and the local architects and engineers from the onset regarding the criteria for the preservation photographic materials cannot be understated. Having their expertise and input in support of our goals was invaluable in terms of setting a high standard for the project.

A significant point of discussion during this team meeting was the location for the climate-controlled storage vault for photographic collections. The original idea proposed included renovating three adjacent offices on the second floor of ASM building 26 to convert them to one large area with compact mobile shelving and a dedicated air-handler. While historic photographs of the building revealed these offices were not original to the construction of the building, and therefore could be considered for renovation, preliminary inspection during this meeting by UAFM and GLHN engineers called into question whether the floor in this area could support the weight of the compact mobile shelving without requiring significant structural reinforcement from below. For this reason, an alternative location for the photographic storage suite was proposed and will be discussed below.

The problem with moving forward with the plan to renovate the original proposed area on the second floor was that the area on the first floor directly below includes part of the museum lobby, the security office, the museum shop and the central stairway. "The central lobby features 14' high side walls of plaster and Tavernille Claire marble with a rose-colored base. The floor and central stairway beyond are

pink Tennessee marble."[1] The ceiling of the lobby extends over "the central open monumental stairwell which leads up to a generous landing that then splits into two matching sets of stairs that continue up"[2] to the second floor. The portion of the lobby ceiling that extends over the stairway is directly below the three rooms initially proposed for renovation. The lobby ceiling has a decorative painted molding that extends around the perimeter and is believed to be original. The potential need for the introduction of structural supports from below would severly impact the lobby ceiling. Following the advice of the architects, engineers and historic preservation advisor, the team redirected our efforts to developing Plan B.

Plan B consists of renovating room 328, also in building 26 (Appendix 1). Room 328 is not part of the original 1926 construction but is a later addition to the third floor that was completed in 1963.[3] It has two entrances, one on west side from the corridor (Figures 1-2) the other on the south side from room 304 (Figure 3). Room 328 is a two-tiered library stack area with built-in shelving designed to hold books and documents (Figures 4-6). It has been used to store a variety of collections, but not without difficulty and challenges. The shelving is immovable and not designed to hold large three-dimensional objects (Figures 7-8). The lower tier provides a considerable amount of support for the upper tier (Figure 9-10). Vertical air ducts are built into the shelving system and run between the two tiers (Figure 11-12). The air-handler that serves this room is a four-pipe multi-zone system with separate chilled water and hot water coils that is not equipped to control humidity. The room was retrofitted with fire suppression, but the low ceiling heights do not allow for adequate clearance between the pipes/sprinkler heads and upper shelves (Figure 13-16). There are minor leaks at some of the joints and sprinkler heads, and some of the pipes are of lesser grade steel and show visible signs of corrosion (Figure 17-18). The plaster ceiling on the second tier has sustained damage over the years, both from the installation of electrical conduit and the fire suppression system, but also from leaks in the roof (Figures 19-22). The roof over this area is built up on 3" insulation on a metal deck and has been repaired several times (Figures 23-24).[4] The most recent repairs were made in 2012 (flat roof above room 328) and 2013 (pitched tiled roof that drains onto flat roof) (Figure 25). The leaks have been addressed, but the plaster damage has not. The renovation of room 328 will allow ASM to address these long-standing issues and at the same time provide significantly improved storage conditions for the photographic collections.

This new plan requires the complete deconstruction of the mezzanine to accommodate compact shelving. The loss of the vertical storage space will be partially regained with the installation of ten-foot-tall compact shelving in the south half of the room. The single level footprint for compact shelving in Room 328 will more than double the capacity that would have been provided by the renovation of the area that was initially proposed. In addition, this plan allows for space at the north end of the room to be used for the installation of a walk-in cooler and freezer, thus providing three different preservation environments to accommodate the range of photographic media in the collections. Usable space along the west wall will accommodate a work counter with storage cabinets below and above. The overall extra space in this plan will allow for anticipated growth of the physical collection in a way that the original proposed plan was limited. See the General Arrangement Plan provided by GLHN (Appendix 2).

Because room 328 was purpose built to hold the two-tiered library stacks, its floor was constructed to carry a substantial load. In January 2015 the structural engineer determined that the building structure

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[1] Burns and Wald-Hopkins Architects, Ann Beha Associates, Inc., *Arizona State Museum Master Plan,* University of Arizona Project No. 01-8252, p. 17. (June 2001)

[2] Ibid.

[3] Ibid. p. 19.

[4] Ibid. p. 21.

in this area can support 250 pounds per square foot. Preliminary estimates from Spacesaver® for compact shelving indicated that the weighted shelving will equate to 239 pounds per square foot.

The 18-foot floor to ceiling height created by the removal of the mezzanine allows for the upgrade of the fire protection system to meet current building codes. Air ducts will be installed overhead for improved circulation of conditioned air throughout the room. Electrical upgrades required for security, the mobile shelving, walk-in cooler and freezer, lighting, etc., will be implemented.

The renovation of room 328 requires the relocation of the varied collections that are stored there currently. This is something that ASM has been working to address in recent years and which falls in line with the museum's long-range plan for relocation of bulk archaeological collections to off-site storage, freeing up space in building 26 for other museum collections.

Upon the revision of the original plan, Moreno contacted the NEH Program Officer to vet the proposed location changes. Because the revisions hold true to the original proposal to design a sustainable storage environment for ASM's photographic collections, the location change was determined to be appropriate. As such, the team was able to continue with the planning process.

During the October 2014 site-visit, IPI consultants worked with ASM and UAFM personnel to begin the evaluation of the HVAC systems for ASM building 26. Team members worked together to deploy the newly purchased PEM2 environmental dataloggers in areas where photo collections are stored and in room 328. IPI consultants instructed ASM personnel on how to download environmental data, how to review it and generate reports using *e*ClimateNotebook software. UAFM Energy Conservation Project Managers provided detailed information on the building's mechanical systems to the IPI consultants which helped to inform their evaluation and eventual recommendations for short and long-term solutions for creating a better preservation environment for the photo collections.

July 30, 2015, GLHN submitted the previously noted General Arrangement Plan (Appendix 2) for room 328, which included a proposal to create three separate climate zones in the room: one for frozen storage, one for cold storage and one for cool/room temperature storage. A walk-in freezer, a walk-in cooler, and a dedicated air-handler with humidity control would create the three zones. The determination for the need for three separate climate zones came out of discussions between ASM personnel and IPI consultants about the contents of the collections and best practices for the preservation of different photographic media.

Preliminary specifications for the size of the walk-in units yielded estimates for overall storage capacity. GLHN estimated that the walk-in freezer would store up to 1,500 5 ¾ x 4 5/8-inch archive boxes of nitrate, acetate (negative, film, slides, transparencies, etc.), polyester, photographic prints and ink jet materials in a -20°C (-4˚F) and 45% RH environment. Likewise, GLHN estimated that the walk-in cooler would store 3,000 5 ¾ x 4 5/8-inch archive boxes of glass plates, magnetic media, and digital media, in a 5°C (41˚F) and 45% RH environment. Both would require evaporators and dehumidifiers. The two walk-in units would take up the northern half of the room.

The remaining half of the room would be equipped with compact shelving system that would hold up to 21,600 5 ¾ x 4 5/8-inch archive boxes of black and white prints. The dedicated air-handler for room 328 would have different set points to allow for seasonal change. IPI made recommendations on what these different set points should be in their final report. Because curatorial staff will need to work in the room to carry out various tasks, the set points will allow for a certain degree of human comfort. The set points for the September to June will be 18°C (65°F) and 30% RH, reflecting the low ambient relative humidity of the Sonoran Desert through much of the year, and the set points for July to September will

be 18°C (65°F) and 55% RH to allow for the higher relative humidity that Tucson endures during the summer monsoon season. The allowance for seasonal change is intended to balance preservation conditions for the generally more stable materials that will be stored in the main room with energy efficiency and conservation.

Following the submission of this general arrangement plan by GLHN in July 2015, team members spent the next twelve months working toward the completion of the planning phase. IPI team members worked with ASM staff to evaluate environmental data as it was collected. Together with UAFM and GLHN, the team investigated options to mitigate problems posed by the limitations of the existing air-handler. GLHN also consulted with IPI, researching options for walk-in freezer and cooler units.

In April 2016, IPI submitted a draft of their report *Mechanical System Design Consultation: Arizona State Museum Photographic Collection Storage* to ASM for review and comments. This draft report was passed on to GLHN for review as well. On April 29, Moreno was notified by Doug Stingelin, Mechanical Engineer with GLHN, that he would replace Patrick O'Brien who had left the company. The information provided in the IPI draft report assisted in making this change in GLHN personnel relatively seamless.

In May 2016, ASM consulted with IPI to review the IPI recommendations and discuss the feasibility of GLHN's proposed three-climate zones. During these conversations two significant topics were addressed. First, the team reviewed the pros and cons of installing walk-in freezer and cooler units versus utilizing a fleet of commercial freezers. IPI advised that while investing in the installation of walk-in units would be more expensive at the outset, they would provide better energy savings than a fleet of 8-10 commercial freezers. Another benefit of the walk-in units is that they would also allow for growth of the collection that is projected, whereas accommodating more commercial freezers would be more difficult. IPI team members indicated that we should expect and plan for at least another ten to twenty-year period during which our film and print collections will likely grow as retiring professors, researchers, and photographers look to bequeath their collections of their life work to the museum. This is a phenomenon that ASM is already experiencing. Additionally, the heat emitted from a fleet freezer would require greater energy expenditure from the air-handler to control the preservation environment inside the room. Heat from the walk-in units' mechanical systems will be exhausted out of the room.

The second significant topic of discussion also took into consideration overall energy consumption balanced against long-term preservation goals. The team focused on IPI's temperature recommendation for frozen storage of -20°C (-4˚F) and 45% RH to achieve the highest possible Preservation Index (PI)[5] of 9999. For comparison, the IPI recommendation for cold storage is 5°C (41°F) and 45% RH for a PI of 360. IPI clarified that walk-in freezer temperatures don't have to go much below freezing (0°C (32°F)) to extend the preservation of photographic materials. A frozen storage temperature of even -4°C (25°F) would still slow the rate of decay, providing a PI of 1306, but it would not require as much energy to maintain as -20°C (-4°F). IPI's Dew Point Calculator[6] was used to compare the rate of chemical decay at temperatures at and below freezing. The preservation gains were not significant enough below -4°C (25°F) to warrant the extra costs in terms of equipment and energy efficiency.

Following this consultation discussion with IPI, ASM regrouped with UAFM and GLHN to ensure that Doug Stingelin, GLHN Mechanical Engineer who was new to the project, understood the goals and scope

[5] Preservation Index (PI), is an algorithm that estimates the rate of chemical decay that would occur in organic materials in given temperature and relative humidity conditions and is used for comparative analysis of environmental conditions.
[6] See www.dpcalc.org.

of the project. Details regarding the mechanical systems for the room and the walk-in units, air-intake and exhaust, the potential need for CO2 detection, appropriate fire protection systems, electrical and shelving (i.e. millwork), etc. were addressed. Over the next couple of months, GLHN worked to produce a schematic design and cost estimate for the project based on input from ASM and IPI. The final document, *Arizona State Museum Photographic Archive Storage Schematic Design and Cost Analysis*, was submitted to ASM on September 9, 2016, and provides two different options for renovation of room 328 (Appendix 3).

Option 1 entails the demolition of the existing library shelving system, mezzanine, staircase and small materials elevator, replacing it with a one (1) level movable storage system and a small mechanical equipment platform to accommodate the two walk-in units. The range of probable construction cost for this option was estimated to be $1,160,000 - $1,645,000.

Option 2 entails the demolition of the existing library shelving system, mezzanine, staircase and small materials elevator, replacing it with a two (2) level movable storage system, erecting a new steel deck with pour concrete mezzanine as well as a small mechanical equipment platform to accommodate the two walk-in units. The range of probable construction cost for this option was estimated to be $1,340,000 - $1,930,000

Option 2 maximizes floor to ceiling space in the room, increasing only slightly the overall storage capacity, but building codes would limit the allowable area of the mezzanine and this option may require seeking code variance. Option 1 would provide the necessary storage required to accommodate the ASM collection at lower price and still allow for growth.

Simultaneously to the production of the GLHN schematic design and cost analysis, IPI worked to update their *Mechanical System Design Consultation* based on input from UAFM and GLHN. Anticipating scheduling conflicts, IPI asked ASM to consider requesting a no-cost extension for the grant to allow them to complete the revisions to their report. Because Moreno was scheduled to take sabbatical from January 1, 2017 to June 30, 2017 a twelve month no-cost extension was requested on September 12, 2016 and approved. The extra twelve months, also allowed for another full year of environmental data to be collected which, provided IPI with a better picture of the museum environment on which they could base their report. Weakly maintained routine downloads and assessment of the environmental data while Moreno was away.

Upon returning from sabbatical in July 2017, Moreno resumed communication with IPI to finalize the revisions for their report. On August 15, 2017, Moreno was notified by IPI Executive Director, Jae Gutierrez, that preservation environment specialist, Jeremy Linden, who had been ASM's primary IPI consultant, would be leaving IPI. Chris Cameron took over as the IPI lead on the project and worked to finish their report, which was submitted to ASM on September 8, 2017 (Appendix 4).

With all major goals of the NEH SCHC Planning Grant complete, Moreno and Weakly began working on the Final Performance Report for the Planning Grant. While working on the Final Financial Report, Moreno discovered an accounting error that resulted in there being more money remaining in the grant than had been previously reported to her by the University's business office. The remaining funds amounted to $8,573.05 and were what remained of the additional $10,000 that ASM was awarded to carry out one or more recommendations made by the planning team. Moreno immediately contacted NEH Program Officer, Jesse Johnston, for guidance. He recommended requesting another twelve month no-cost extension to provide ASM ample time to identify specific IPI recommendations for improving the environment that could be addressed with the amount of funds available. On September

18, 2017 a second no-cost extension was approved by NEH.

One of the recommendations that IPI made in their report was to add dehumidification to our existing photo collections storage areas. Moreno and Weakly consulted with UAFM and GLHN to determine the feasibility of installing desiccant dehumidifiers on existing ductwork to try to control humidity in current storage rooms until the proposed renovations can be implemented. A quick assessment of the scope of the work required determined that it was not possible with the funds available. An alternative option discussed with IPI included using portable dehumidifiers to control RH in the photo collection storage rooms for the short-term.

Another recommendation by IPI relating to environmental monitoring was to try to collect additional environmental data from inside collection storage cabinets and archival housing materials to try to assess the level of protection and buffering that storage materials are able to provide to the photographic materials during periods of extreme environmental conditions.

With these two goals in mind, Moreno and Weakly proposed to use the remaining $8,573.05 grant funds to purchase six Frigidaire FAD704DWD 70-pint dehumidifiers for use in all the areas where photo collections are currently stored until we can move forward with implementation. In addition, the remaining funds were used to purchase ten more PEM2 environmental dataloggers to be deployed throughout photo collections storage, and a 5-year professional subscription to eClimateNotebook that will enable ASM to maintain its environmental monitoring program that was developed (and since expanded on) through this planning project. These expenditures were approved by the NEH Program Officer.

Upon ASM's initial receipt of this NEH SCHC Planning Grant, three short articles on the project were published, one from ASM (Appendix 5), one from the local newspaper (Appendix 6), and one from Arizona Humanities (Appendix 7). (Additional publicity will be sought as part of the implementation process and to help with fundraising.)

Works Cited

Burns, David, and David Wald-Hopkins Architects, and Ann Beha Associates, Inc. *Arizona State Museum Master Plan.* University of Arizona, Project No. 01-8252. Unpublished report, 2001.

Linden, Jeremy, and Christopher Cameron, Image Permanence Institute. *Mechanical System Design Consultation: Arizona State Museum Photographic Collections Storage, November 2014 – November 2016*. Unpublished report, 2017.

Stingelin, R. Douglas, and LouAnne Wegrzyniak, GLHN Architects & Engineers, Inc. *Arizona State Museum Photographic Archive Storage: Schematic Design and Cost Analysis*, Job No. 1464.10. Unpublished report, September 9, 2016.

**B. Accomplishments**

The primary goals, outlined above in section A., were accomplished. The project team evaluated the physical space and environment where the photo collections are currently stored. Upon determining that this space initially proposed for renovation was not suitable, the team worked to develop a plan B for renovation of a different area of the museum to create a multi-climate-controlled suite for long-term storage, curation and preservation of ASM's photographic collections. The decision to move forward with Plan B was dependent on the structural evaluation that was conducted early on to assess floor load capacity to support compact mobile shelving.

To help guide this planning process, ASM used grant funds to purchase environmental datalogging hardware and a software subscription and hired IPI Preservation Environment Specialists to assist in setting up a new environmental monitoring program to provide detailed data on the museum's current environmental conditions.

ASM collaborated with IPI and UAFM to assess the museum's antiquated HVAC system and determine what measures could be taken to improve preservation conditions for the photo collections and improve energy efficiency as possible.

In the end, two years of environmental data were collected that informed the IPI environmental and mechanical assessment. (Four years of environmental data have been collected over the course of the grant period and are reported here in Appendix 8.) It, in turn, informed the development of the schematic design, with architectural diagrams, and cost analysis provided by GLHN. Design criteria for the walk-in freezer and cooler units, and for the dedicated air-handler for room 328 were developed through collaboration between ASM, IPI, UAFM and GLHN. Specifications for electrical and fire protection upgrades were included. Unlike the rooms that were initially proposed for renovation, because room 328 is already an alarmed space, further upgrades were not pursued as part of this project.

In redirecting the focus of the renovation project to room 328, consideration was given to the need to comply with Section 106 of the National Historic Preservation Act (NHPA). Room 328 is not, however, part of the original Building 26 construction that dates to 1926. It is part of the 1963 additions to the building. Still, UA Historic Preservation Committee members were consulted regarding the change in areas proposed for renovation. Team members were made aware that the project would have to undergo Section 106 review prior to commencement of the implementation phase of the project.

**C. Audiences**

ASM's Photographic Collections reach many diverse and varied audiences. From the visitors who walk in the doors to those who visit online, the images in ASM's collections reach wide groups of people locally and around the world. While direct access to the Photo Collections is by appointment only and this itself is restricted due to limited staffing, many photographs are available for public viewing either online or within ASM exhibits. ASM staff frequently use the Photographic Collections for exhibits, publications, marketing, preservation, ethnological documentation, outreach, and education. ASM audiences include UA and K-12 students, scholars, collectors of Indian Art, as well as members of descendant communities. Ethnographic photographs are often utilized by tribal members and Indian artists for their own research and inspiration. For example, in 2012, a family of Maricopa people came to see the Linderman collection photographs. Because of their visit, those sixty-five photographs were digitized and placed online with metadata on the Arizona Memory Project. Now, all members of the Pima-Maricopa Salt River Community can access the photographs. Archaeological photographs are accessed by many researchers who are excavating sites previously excavated or surveyed. In addition, the photographs play an important role in the stewardship of Arizona's numerous sites. The underlying goal of the project, to preserve ASM's Photographic Collections, will benefit all these audiences.

**D. Evaluation**

This project was not evaluated as part of the planning process itself. However, the products of the NEH SCHC Planning Grant informed the development of two additional grant proposals, an NEH SCHC Implementation Grant for $350K and a National Park Service Save America's Treasures Grant for $500K

(administered by the Institute of Museum and Library Science) that were both awarded in the fall of 2018 to support this project. That these proposals were successful can ben seen as positive evaluation of our planning process. Reviewers comments were positive and supportive overall.

**E. Continuation of the project**

As indicated in section D, there are definite plans to continue this project after the grant period. Moreno and Weakly are co-investigators on an NEH SCHC Implementation Grant for which $350K was awarded (October 1, 2018 start) to purchase mobile shelving for the main part of room 328 and to support some basic renovation costs. Moreno and Weakly are also co-investigators on a National Park Service Save America's Treasures (SAT) Grant (November 1, 2018 start). In addition to designating ASM's photographic collection as a national treasure, this award for $500K, which is administered by the Institute of Museum and Library Science, will support the purchase and installation of the walk-in units. The SAT designation also aides in ASM's ongoing fundraising efforts in support of this project.

In addition to moving forward with preparations for renovation, Moreno and Weakly continue to monitor the museum environment where photographic collections are stored. Data collected illustrate the poor preservation conditions, and summary reports for each room indicate the types of damage that an unstable environment can cause to museum collections in general. Monitoring will continue while the photo collections remain in their current locations. On-going monitoring will enable ASM staff to assess whether the newly purchased portable dehumidifiers are effective better controlling the environment. Once renovation is complete, and collections can be relocated into the new multi-climate suite (after a prescribed period for outgassing), NEH funded environmental dataloggers will be used to monitor the preservation environment in the new storage area. In addition to providing reliable data for securing additional federal funding to support this project, there has been a clear benefit to using PEM2 dataloggers and eClimateNotebook software in enhancing ASM's staff's ability to demonstrate to ASM and UA administrators the current environmental conditions and the problems they cause.

**F. Long Term Impact**

This NEH SCHC Planning Grant resulted in the development of a solid plan and cost estimate to move forward with the renovation of a multi-climate suite. The long-term impact will be ASM's ability much improved ability to protect and preserve it's valued Photographic Collection. Additionally, ASM now has a way to effectively monitor the museum environment at a level of accuracy that was not possible before given our outdated and barely functional equipment. We are now better equipped to educate our staff about the importance of a continuous monitoring program. With the data that we collect we are more quickly able to respond to changes/problems with our antiquated air handlers and reliably deploy the assistance of our UAFM colleagues.

**G. Grant Products**

Two significant and influential products of this NEH SCHC Planning Grant are the *Mechanical System Design Consultation* report produced by preservation environment specialists at IPI and the *Schematic Design and Cost Analysis* produced by GLHN for the renovation of room 328. These two documents, which were supported by environmental data collected over the course of the grant period, were invaluable to Moreno and Weakly in writing our most recently funding grant proposals. As already emphasized, addition products include the environmental monitoring equipment and software, along with the portable dehumidifiers which will afford us some measure of environmental control until our renovation project is complete and the photographic collections can be appropriately rehouse in their new custom climate storage suite.

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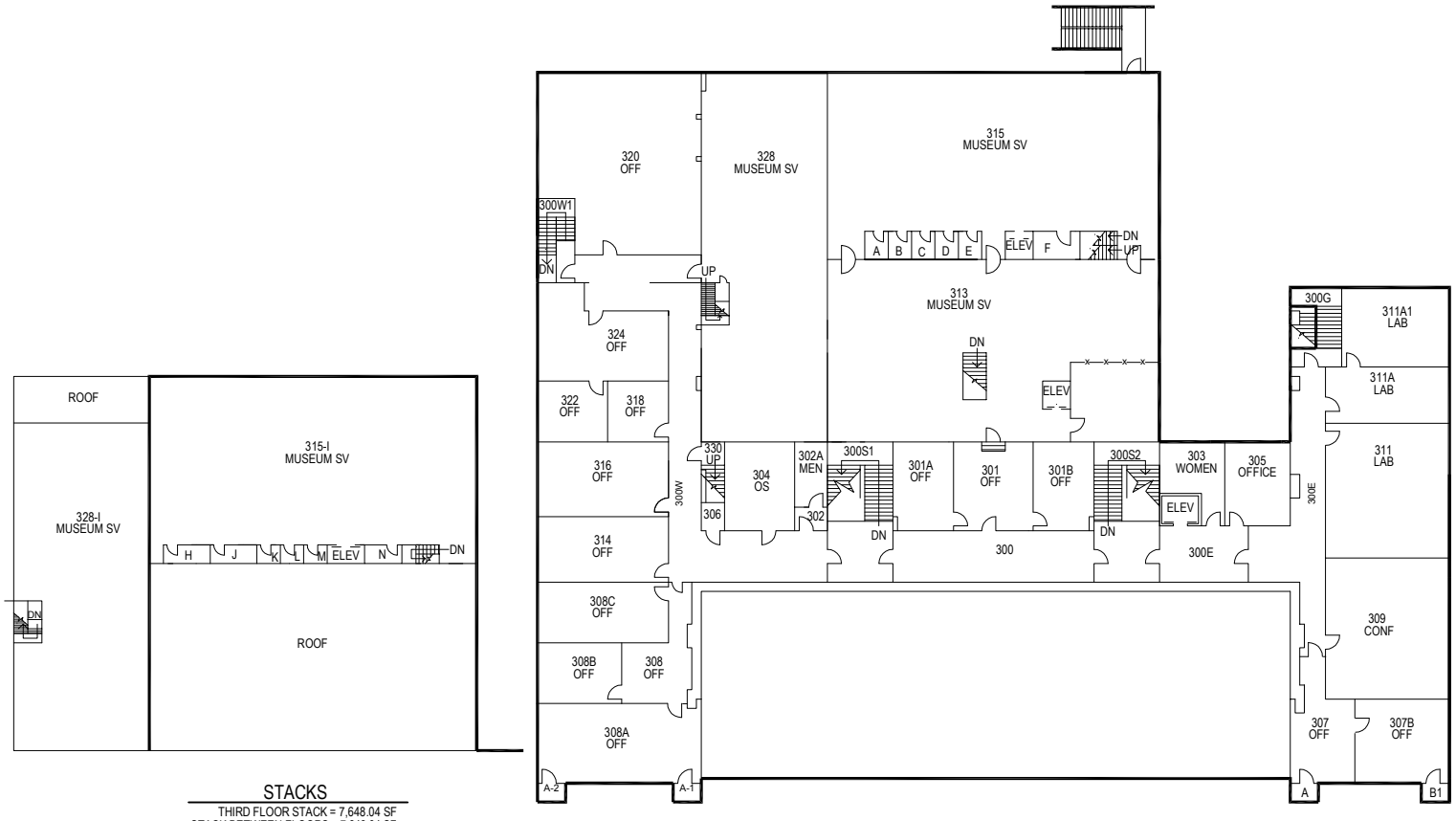



STACKS

THIRD FLOOR STACK = 7,648.04 SF
STACK BETWEEN FLOORS = 7,648.04 SF
TOTAL = 15,296.08 SF

## THIRD FLOOR

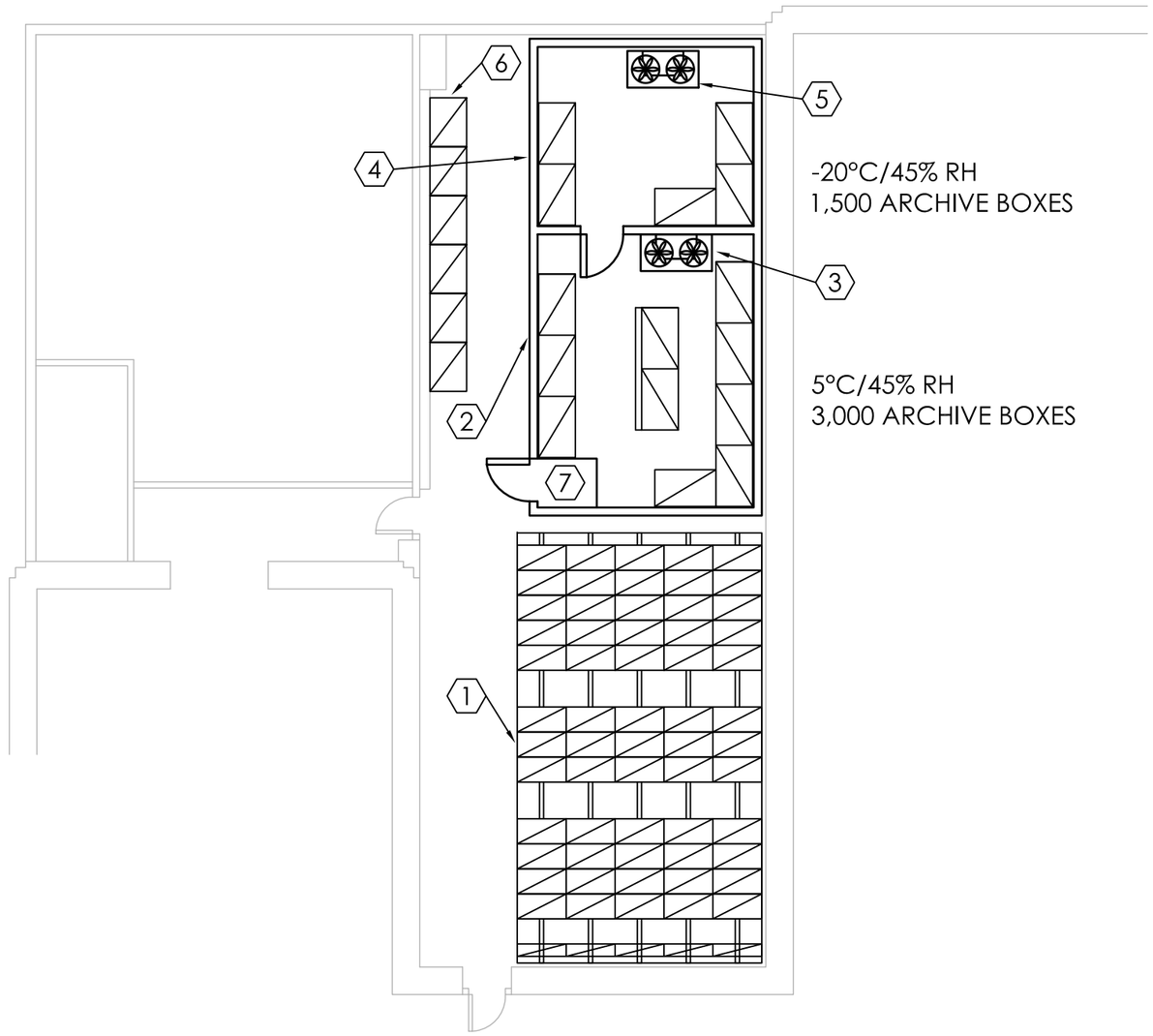
GROSS AREA = 12,351 S.F.

4/4

0' 10' 20' 40'

ARIZONA STATE
MUSEUM NORTH
1013 E. UNIVERSITY BLVD.
TUCSON, AZ

UNIVERSITY OF ARIZONA
REAL ESTATE ADMINISTRATION




## A2 GENERAL ARRANGEMENT PLAN

SCALE: 3/32" = 1'-0"

## GENERAL NOTES

1. STORAGE CAPACITIES ARE BASED UPON A STANDARD ARCHIVE PHOTO BOX WITH THE DIMENSION OF 5¾" WIDE X 4-5/8" HIGH X 10½" DEEP.
2. WALK IN COOLER AND FREEZER SHALL BE A PRE-ENGINEERED PACKAGE ASSEMBLED, TESTED, AND COMMISSIONED BY A FACTORY APPROVED CONTRACTOR.
3. WALK IN COOLER DESIGN CONDITIONS SHALL BE 5° C, 45% RELATIVE HUMIDITY.
4. WALK IN FREEZER DESIGN CONDITIONS SHALL BE -20°C, 45% RELATIVE HUMIDITY.
5. WALK IN COOLER AND FREEZER SHALL HAVE DEDICATED EVAPORATOR AND DEHUMIDIFIER UNITS TO MAINTAIN SPACE CONDITIONS.

## ⬡ KEYNOTES

1. COMPACT SHELVING SYSTEM. 21,600 ARCHIVE PHOTO BOXES (5¾" WIDE X 4-5/8" HIGH X 10½" DEEP). TOTAL MEDIA WEIGHT 124,200.0 POUNDS. TOTAL FOOTPRINT AREA 815.78 SQUARE FEET. TOTAL WEIGHT 168,524.0 POUNDS.
2. WALK IN COOLER. 5 DEGREES C, 45% RELATIVE HUMIDITY.
3. WALK IN COOLER EVAPORATOR ABOVE, DEHUMIDIFIER BELOW.
4. WALK IN FREEZER. -20 DEGREES C, 45% RELATIVE HUMIDITY.
5. WALK IN FREEZER EVAPORATOR ABOVE, DEHUMIDIFIER BELOW.
6. WORK AREA BENCHES.
7. RAMP INTO WALK IN COOLER. WALK IN COOLER FLOOR IS 12" HIGH.

| No. | REVISIONS/SUBMISSIONS | DATE |
|---|---|---|

THE UNIVERSITY OF ARIZONA

THE UNIVERSITY OF AIRZONA
PROJECT TITLE
PROJECT TITLE

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|---|---|
| PROJECT NO. | 1464.10 |
| DESIGN BY: | |
| DRAWN BY: | |
| CHECKED BY: | |
| DATE: | 2015/07/30 |

# ARIZONA STATE MUSEUM

# PHOTOGRAPHIC ARCHIVE STORAGE

GLHN JOB No. 1464.10

## SCHEMATIC DESIGN AND COST ANALYSIS

9/9/2016

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**Executive Summary:**

GLHN developed a schematic design and opinion of probable construction cost for the Arizona State Museum's photographic archive collection based on 1) the Image Preservation Institute's recommended criteria and 2) locating the storage in Room 328 at the Arizona State Museum's North building on the University of Arizona main campus. Two spatial options for long-term storage were evaluated:

Option 1: Demolish existing library shelving system, mezzanine, staircase, and small materials elevator, replacing with a one (1) level movable storage system and a small mechanical equipment platform. Option 1 would provide the necessary storage required for the photo archive collection at a lower cost, capable of storing 22,400 photo archive boxes.

Range of Probable Construction Cost: **$1,160,000 – $1,645,000**

Option 2: Demolish existing library shelving system, mezzanine, staircase, and small materials elevator, replacing with a two (2) level movable storage system, erecting a new steel deck with poured concrete mezzanine as well as a separate mechanical equipment platform. Option 2 maximizes space use providing comparable storage to Option 1, and provides additional space for expansion with full floor-to-ceiling height. There are building code challenges with Option 2 – the allowable area of the mezzanine is limited to one-third the area of Room 328 due to limited sprinkler coverage in the building. Pursuing Option 2 may require seeking a code variance from the University's Planning, Design, and Construction office.

Range of Probable Construction Cost: **$1,340,000 – $1,930,000**

The lower range in probable cost highlights the potential for substantial savings by pre-purchasing high-dollar items such as the Movable Storage System and Walk-In Coolers.

Existing mechanical, electrical power and lighting, as well as fire alarm and fire protection systems will be replaced. A new Secure Access system is desired and would be furnished and installed by the University.

GLHN recommends that ASM pre-purchase major furnishings and equipment to avoid contractor mark-up costs and pursue either long-term storage option based on available funding. Both options for long term storage are adequate to capture the Image Performance Institute's criteria for photographic storage. Option 2 allows for greater space utilization and more options for space adaptability in the long term.

**Introduction:**

GLHN Architects and Engineers, Inc. (GLHN) was hired by the Arizona State Museum (ASM) to develop schematic plans and opinions of probable cost to assist funding efforts for a new climate-controlled storage space in ASM North Building, Room 328, which would house ASM's Photographic Archive Collection. This report documents spatial programming and cost metrics for the two options.

As a part of a National Endowment for the Humanities Sustaining Cultural Heritage Collections Planning Grant, ASM contracted with the Image Permanence Institute (IP) to provide expertise of the design and location of a mechanical system that would serve their photographic collection. The photographic collection held by ASM contains over 500,000 photographic images, negatives, transparencies, and glass slides, as well as over 250 films. The collection consists of a wide range of photographic materials, including nitrate, acetate, polyester, and glass, all requiring different preservation conditions.

Some films in the collection suffer from vinegar syndrome, emitting a sharp acidic odor due to the degradation of the cellulose acetate film base, which can also cause distortion, brittleness, and shrinkage. These chemical reactions are influenced by storage conditions, such as heat and moisture, and the presence of acidic vapors from nearby. More specifically, the collection's nitrate-base films pose a particular concern as nitrate film can also emit acidic gases as it deteriorates, and is highly flammable. These films are currently stored in an onsite freezer to slow the decay rate of the film improving the life of the material, as well as reducing the risk of combustion. Current storage conditions for the collection are lacking in moisture control, exhibit excessive space temperatures, and poor air distribution to properly house the complete photographic collection.

The criteria for new photographic collection storage space provided by the Image Preservation Institute are as follows: The storage space must be in proximity to the museum, be a long-term solution to the storage and environmental needs addressed above, have the ability to add a refrigerator and freezer, have enough additional space for future collection additions over the next 15-20 years, and exhibit environmental conditions suitable for long-term collection preservation. In a survey performed by ASM, Room 328 in the ASM North building was found to be the best option for long-term collection storage, with the installation of a walk-in freezer and walk-in refrigerator.

The Arizona State Museum North building is located at 1013 E University Blvd. in Tucson, AZ 85721 on the University of Arizona main campus. The building was originally built in 1926 as a library for Arizona State University. Today, the building is used mainly for museum exhibitions, collection storage, and offices. Room 328 was part of the 1962 expansion made on the building and once served as the state archives. Currently it is used for collection overflow storage.

The existing photographic collection is currently housed in five (5) separate locations shared between two (2) buildings, Building 26 (ASM North) and Building 30 (ASM South), in attempt to store similar collections together. Nearly all spaces currently exhibit room temperatures exceeding the recommendation for preservation, and most of these spaces are additionally prone to large changes in relative humidity, swinging from 20-30% most of the year then up to 60% from July to mid-September. These current spaces have been deemed unacceptable for image preservation as extended periods of exposure to high temperatures and humidity accelerate the rate of chemical decay of organic materials.

Room 328 was identified as a favorable and available space to consolidate and relocate ASM's photography archive collection.

**Photographic Archival Long-Term Storage Program**

The principal goal of the design program is to fully capture the Image Preservation Institute's criteria for ASM's photographic collection storage. The following commentary outlines a systematic approach to outfit Room 328 for archival photographic storage.

**Spatial/Structural**

Existing: Room 328 is a long and tall rectangular space, with a floor-to-structure height of 15ft. and a floor plate of approximately 2160 sq-ft, making it large enough to store the entire collection while leaving some additional room to use as a flex space. The third level floor is anticipated to support the load for the walk-in refrigerator and freezer units, as well as the additional mezzanine loads. The room has only a north wall and roof exposure which significantly curbs the cooling and heating loads. Currently the room is split into two levels by a prefabricated steel mezzanine designed specifically for library book storage (stack system), with a staircase and small materials elevator giving access to the second level. Each level's shelving systems doubles as structural support.

Required Demolition: The existing stack system will need to be removed in entirety as the integral vertical supports would prohibit the installation of new movable storage, walk-in cooler/freezers, and circulation.

Architectural Code Analysis: A cursory code analysis of the existing building has been completed. It appears that the existing facility is a nonconforming construction type. Nonconforming simply means that not all the components of the building meet the current requirements of the building code, although they are assumed to have met the requirements of the codes that were in place at the time of construction. Per The 2012 International Building Code (IBC) the Arizona State Museum is a mixed occupancy facility housing occupancy groups A-3, B, S-1, S-2 and F-1. The photography archives are classified as S-1 storage space. The facility is only partially equipped with an automatic fire sprinkler system, therefore, provisions in the code which allow longer travel distances and increase in mezzanine size due to sprinkler system throughout facility will not be permissible for this project.

New Constructions: Room 328 interior walls will be repainted with a vapor-retarding latex paint to curb moisture migration into and out of the space. Additionally, the existing door will be removed and be replaced with an insulated and gasketed door. A platform will be erected at the North-end of 328 above the refrigerated walk-in cooler and freezer to support and maintain mechanical/HVAC equipment. Ideally the mechanical platform would be constructed with a poured concrete slab bearing on a steel structure and with an enclosed (framed-in) mechanical space to attenuate noise.

Options for long-term storage capacity:

Option 1: Install a movable storage system capable of storing 22,400 archive photo boxes. All movable storage and walk-in refrigerated chambers will reside on one floor.

Option 2: Install a new steel-framed mezzanine structure with a poured concrete floor, and new staircase for a two-level movable storage system capable of storing an equal amount of storage capacity while also leaving room for additional future storage.

Per IBC 505.2.1, mezzanines are limited to one-third the area of the room they occupy. The mezzanine shall not exceed 720 square feet. IBC 505.3.1 also allows an equipment platform. The aggregate area of the equipment platform and the mezzanine shall be not greater than two-thirds of the area of the room in which they are located (room 328). This equates to 1,440 square feet.

IBC also requires that the automatic fire sprinkler system be installed both above and beneath the mezzanine and equipment platform.

**Acceptable Indoor Environments**

Three (3) levels of precision climate-controlled storage space are desired:

Room 328 Ambient Storage Environment Requirement:

- June-September: Maintain 60-65°F with a relative humidity of 55%
- September-June: Maintain 60-65°F with a relative humidity of 30%
- Tolerance: ± 2°F, ± 5%RH

Room 328 Freezer Archival Storage Chamber:

- Year Round: Maintain -4°C (25°F) and 45% RH
- Tolerance: ± 1°F, ± 5%RH

Room 328 Cool Archival Storage Chamber:

- Year Round: Maintain 5°C (41°F) and 45% RH
- Tolerance: ± 1°F, ± 5%RH

Existing: Room 328 is currently served by one of the oldest air-handling units in the facility, which was designed for human comfort and does not have the capacity for humidification and dehumidification nor the means for precision climate control. The current air-handling unit is a multi-zone unit which serves most of the building's 1962 addition as well as Room 328, and is not able to provide the specific temperature range required for proper image preservation. Herein, it is necessary to replace the current HVAC system serving Room 328 with a dedicated air handling unit, overhead ducted air system, and robust digital controls.

Required Demolition: Disconnect and remove all ductwork and air devices currently serving Room 328. Decommission existing multi-zone unit zone 4. Patch and seal all existing floor openings that remain from vacated or removed ductwork.

New Constructions:

Two (2) modular prefabricated and field-erected walk-in coolers (refrigerator and freezer) will be installed at the north end of the space. The walk-in coolers will be constructed with 4" fire retardant and air-tight foamed in-place urethane walls, ceiling and floor. The walk-in coolers will be procured as a turn-key solution, complete with packaged HVAC, power and lighting, security access, and precision climate controls.

Freezer Storage: ~15' x 18' x 10'4" tall

Cooler Storage: ~18' x 23' x 10'4" tall

The walk-in freezer unit's relative humidity and temperature set point provides excellent conditions for long-term storage of nitrate, acetate (negatives, films, slides, transparencies, etc.), polyester, photographic prints, and ink jet print materials. Glass plates, magnetic media, and digital media should not be frozen and should be stored in the walk-in refrigerator unit which will provide excellent conditions for the long-term storage of those materials. Note that the dew-point of the refrigerator does not allow for the ease of transition of materials from the freezer to the refrigerator without condensation. Containers such as plastic bags or a cooler should be used to allow materials to equilibrate before exposure.

The space surrounding the walk-in coolers (Room 328 proper) will be served by a new custom air handling unit and overhead forced-air distribution system with precision climate controls.

New mechanical systems for Room 328 and the walk-in coolers will require chilled water for space cooling and dehumidification, as well as steam for humidification and space heating. Both utilities will be intercepted in the basement and piped to Room 328 via the existing chase space vacated by the demolished multi-zone HVAC system ductwork.

**Other Building Systems**

Plumbing Systems

No Existing Plumbing systems are present in Room 328 and there are no new plumbing needs for the renovated space.

Fire Sprinkler:

Existing: Room 328 is currently fed by a sprinkler system on both levels with wet-pipe conventional pendant and upright heads. Existing coverage design density is uncertain. The new photographic archive movable storage system and contents will occasion a fire sprinkler classification of Ordinary Hazard 1 requiring a design density of 0.15 GPM/SQFT with sprinkler spacing limited to 130 SQFT. A wet-pipe system is not desirable for photo archival storage as an accidental breaking of a sprinkler head fusible link will result in water discharge and could lead to catastrophic material damage.

Required Demolition: Disconnect and remove existing wet-pipe sprinkler system in Room 328.

New Constructions: Install a dedicated pre-action fire sprinkler system akin to what was recently installed in the basketry vault. A pre-action system is favorable because false alarms are not damaging, and the sprinkler system is a dry-pipe system not flooded with pressurized water. Thus accidental breaking of a fusible link will not result in water release. The pre-action system requires a secondary alarming function such as smoke detection to release water to the sprinkler system.

Electric Power and Lighting:

Existing: The current power distribution feeding Room 328 is deficient to power new HVAC and Walk-in Cooler /Freezer motor loads and is lit with fluorescent strip lighting which is destructive in nature to archival materials due to harmful ultra violet light.

Required Demolition: Disconnect and remove all existing power and lighting serving Room 328 and pull all conductors back to their associated panels.

New Constructions: A new 208V 3-phase feeder will need to be installed with a local power distribution panel dedicated to Room 328. Power is available from the service switchboard located in the basement. The pathway for the new power will utilize the existing chase space vacated by the demolished multi-zone HVAC system ductwork. All existing lighting will be replaced with LED lamps.

Access/Security:

A new card access system and video surveillance system is desired and will be furnished and installed by a UA Facilities Management contractor under a separate scope.

**Cost Analysis**

GLHN constructed an opinion of probable construction costs for the aforementioned design programming and following Long-Term Storage Option 1 or Option 2. Cost Metrics were derived from RS Means Construction Cost Data, manufacturer equipment quotations, and regional anecdotal costing.

Opinion of Probable Construction Cost following Option 1: **$1,160,000 – $1,645,000**

Opinion of Probable Construction Cost following Option 2: **$1,340,000 – $1,930,000**

The lower range in probable costing highlights the potential for substantial savings by pre-purchasing high-dollar items such as the Movable Storage System and Walk-In Coolers. Pre-Purchasing equipment precludes multiple mark-ups (overhead, profit, bond, taxes, contingency, etc.) by contractors and sub-contractors.

Principa1 cost contributors (un-burdened):

| | |
|---|---|
| Two Turn-Key Walk-In Coolers: | **$450,000** |
| Movable Storage Option 1: | **$250,000** |
| Movable Storage Option 2: | **$400,000** |
| Mechanical HVAC with Custom AHU: | **$750,000** |

A complete costing summary is provided in Appendix 1.

**Summary and Recommendations**

Outfitting Room 328 to capture the criteria and recommendations of IPI will be a capital intensive venture. Aside from the high costs for major furnishings and equipment (movable storage, refrigerated walk-in coolers), Room 328's third-floor location and lack of large doors or openings through the building envelope will occasion high costs to 1) egress demolition activities, and 2) ingress materials for construction of a mezzanine/platform, mechanical HVAC equipment, Walk-In Coolers, and Movable Storage system.

GLHN recommends that ASM pre-purchase major furnishings and equipment to avoid contractor mark-up costs and pursue either long-term storage option based on available funding. Both options for long term storage are adequate to capture the Image Performance Institute's criteria for photographic storage. Option 2 allows for greater space utilization and more options for space adaptability in the long term.

Appendices:

1 Opinion of Probable Costing
2 Movable Storage Cut Sheets and Information
3 Energy Labs Custom Air Handling Unit for Room 328
4 Turnkey Walk-In Cooler and Freezer Cut Sheets and Information
5 Schematic Drawings

Appendix 1 – Opinion of Probable Costing

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GLHN

# COST ESTIMATE SUMMARY

| | |
|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 |
| PROJ.No.: | 1464.1 |
| DATE: | 08/23/16 |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- ☐ CODE A ( No design completed)
- ☑ CODE B (Preliminary design)
- ☐ CODE C (Finished design)
- ☐ OTHER (Change Order)

| GENERAL CONTRACTOR | | |
|---|---|---|
| **Div.** | **Subcontractor** | **Subtotal** |
| 01 | Gen. Req. | $8,869 |
| 02 | Demolition | $12,100 |
| 03 | Interior Concrete | $6,425 |
| 04 | Masonry | $0 |
| 05 | Metal Work | $14,581 |
| 07 | Roofing | $0 |
| 08 | Doors/Hardware | $7,865 |
| 08 | Glazing | $0 |
| 09 | Carpeting | $0 |
| 09 | Ceiling | $0 |
| 09 | Framing/Drywall | $9,741 |
| 09 | Painting | $18,150 |
| 09 | Tile Work | $0 |
| 10 | Toilet Accessories | $0 |
| 12 | Millwork | $302,500 |
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| GENERAL CONTRACTOR (CONT.) | | |
|---|---|---|
| **Div.** | **Subcontractor** | **Subtotal** |
| 21 | Fire Protection | $8,712 |
| 22 | Plumbing | $0 |
| 23 | Mechanical | $741,185 |
| 26 | Electrical | $40,737 |
| 28 | Fire Alarm | $4,458 |
| 31 | Earthwork | $0 |
| 33 | UG Utilities | $0 |
| 27 | Telecomm | $0 |
| | Access/Security | $0 |
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| *Subtotal* | | *$1,175,322* |
| Subcontractor Supervision | | 0.0% |
| | | *$0* |
| GC Direct Costs | | |
| **GC Subtotal** | | **$1,175,322** |

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| Owner Contingency | 5.0% | $58,766 | $1,234,088 |
| General Contractor Contingency | 5.0% | $58,766 | $1,292,854 |
| General Contractor Liability | 1.0% | $12,929 | $1,305,783 |
| General Contractor Bond | 1.8% | $23,271 | $1,329,054 |
| General Contractor Overhead | 10.0% | $132,905 | $1,461,959 |
| General Contractor Profit | 5.0% | $73,098 | $1,535,057 |
| General Contractor Tax | 7.2% | $109,757 | $1,644,814 |

***TOTAL OPINION OF PROBABLE CONSTRUCTION COST $1,644,814***

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# COST ESTIMATE SUMMARY

| | |
|---|---|
| **PROJECT:** | ASM PHOTO ARCHIVE OPT. 1 |
| **PROJ.No.:** | 1464.1 |
| **DATE:** | 08/23/16 |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- ☐ CODE A ( No design completed)
- ☑ CODE B (Preliminary design)
- ☐ CODE C (Finished design)
- ☐ OTHER (Change Order)

## GENERAL SUMMARY OF WORK:

## LIST OF ASSUMPTIONS:

This estimate is based on a conceptual design prior to the generation of documents.

This estimate does not include A/E fees, FF&E, Owner Management, or Project costs not explicitly state.

All work is to be performed under a single contract.

All work will be competitively bid as a the Design-Bid-Build project.

No significant escalation will occur for the duration of this project.

No special restrictions will occur during construction.

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## COST ESTIMATE SUMMARY

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| PROJ.No.: | 1464.1 |
| DATE: | 08/23/16 |

**OPINION OF PROBABLE CONSTRUCTION COST**

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- ☐ CODE C (Finished design)
- ☐ OTHER (Change Order)

| MECHANICAL SUBCONTRACTOR | |
|---|---|
| **Second Tier Subcontractor** | **Subtotal** |
| Controls | $0 |
| TAB | $14,216 |
| *Subtotal* | *$14,216* |
| Second Tier Sub Supervision | 3.0% |
| | *$426* |
| Mechanical Direct Costs | *$726,542* |
| **Total Mechanical Cost** | **$741,185** |

| ELECTRICAL SUBCONTRACTOR | |
|---|---|
| **Second Tier Subcontractor** | **Subtotal** |
| Telecommunications | $0 |
| | |
| *Subtotal* | *$0* |
| Second Tier Sub Supervision | 3.0% |
| | *$0* |
| Electrical Direct Costs | *$40,737* |
| **Total Electrical Cost** | **$40,737** |

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# GENERAL REQUIREMENTS COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | GENERAL REQUIREMENTS | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| Rough Carpentry | 1 | LS | | | | | | $2,000 |
| Dumpster Rental 40 Cubic Yards- Weekly Rental | 5 | per day | $930 | $4,650 | | | | $4,650 |
| Hauling, Dump, Return. | 6 | | $30 | $180 | | | | $180 |
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| **Site Construction SUBTOTAL** | | | | **$4,830** | | | **$16** | **$7,330** |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
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## GENERAL REQUIREMENTS COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | GENERAL REQUIREMENTS | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| [INSERT CATEGORY] SUBTOTAL | | | | | |
|---|---|---|---|---|---|

WORKSHEET SUBTOTAL
$7,330

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $733 | $8,063 |
| SUBCONTRACTOR PROFIT | 10.0% | $806 | $8,869 |

| GENERAL REQUIREMENTS CONTRACTOR SUBTOTAL |
|---|
| $8,869 |

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# DEMOLITION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DEMOLITION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
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| **Demolition** | 1 | LS | | | | | | $10,000 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | | | **$10,000** |

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# DEMOLITION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DEMOLITION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$10,000

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,000 | $11,000 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,100 | $12,100 |

| DEMOLITION CONTRACTOR SUBTOTAL |
|---|
| **$12,100** |

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# INTERIOR CONCRETE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | INTERIOR CONCRETE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Mechanical Mezzanine** | | | | | | | | |
| Concrete | 20 | CY | $166 | $3,312 | $98 | $1,968 | $1.50 | $5,310 |
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| | | | | | | | | |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$3,312** | | **$1,968** | **$2** | **$5,310** |

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## INTERIOR CONCRETE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | INTERIOR CONCRETE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$5,310

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $531 | $5,841 |
| SUBCONTRACTOR PROFIT | 10.0% | $584 | $6,425 |

| INTERIOR CONCRETE CONTRACTOR SUBTOTAL |
|---|
| $6,425 |

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## METAL WORK COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | METAL WORK | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Mechanical Mezzanine** | | | | | | | | |
| Steel | 1,000 | SF | $6 | $6,000 | $6 | $6,000 | $0.05 | $12,050 |
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| | | | | | | | | |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$6,000** | | **$6,000** | **$0** | **$12,050** |

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## METAL WORK COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | METAL WORK | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$12,050

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,205 | $13,255 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,326 | $14,581 |

| METAL WORK CONTRACTOR SUBTOTAL |
|---|
| **$14,581** |

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# DOORS & HARDWARE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DOORS & HARDWARE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Door/Frames** | | | | | | | | |
| Single man Door | 2 | EA | | | | | | $1,200 |
| Double Man Door | 1 | EA | | | | | | $3,800 |
| Exterior Wall Louver | 1 | EA | | | | | | $1,500 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | | | **$6,500** |

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## DOORS & HARDWARE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DOORS & HARDWARE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$6,500

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $650 | $7,150 |
| SUBCONTRACTOR PROFIT | 10.0% | $715 | $7,865 |

**DOORS & HARDWARE CONTRACTOR SUBTOTAL**
**$7,865**

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## FRAMING & DRYWALL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | FRAMING & DRYWALL | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Mechanical Mezzanine** | | | | | | | | |
| Wall Framing, Drywall, Paint | 1,000 | SF | $4 | $4,000 | $4 | $4,000 | $0.05 | $8,050 |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$4,000** | | **$4,000** | **$0** | **$8,050** |

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## FRAMING & DRYWALL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | FRAMING & DRYWALL | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$8,050

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $805 | $8,855 |
| SUBCONTRACTOR PROFIT | 10.0% | $886 | $9,741 |

| FRAMING & DRYWALL CONTRACTOR SUBTOTAL |
|---|
| $9,741 |

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# MILLWORK COST ESTIMATE

| | | | |
|---|---|---|---|
| **PROJECT:** | ASM PHOTO ARCHIVE OPT. 1 | **PROJ.No.:** | 1464.1 |
| | | **DATE:** | 08/23/16 |
| **DEPARTMENT:** | ARCHITECTURE | | |
| **CONTRACTOR:** | MILLWORK | | |
| **COMPUTED BY:** | [ABC] | | |
| **CHECKED BY:** | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| Movable Shelving - Single Level 22,400 Archive Boxes Delivered and Installed | 1 | LS | | | | | | $250,000 |

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## MILLWORK COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | MILLWORK | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| [INSERT CATEGORY] SUBTOTAL | | | | | |
|---|---|---|---|---|---|

WORKSHEET SUBTOTAL
$250,000

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $25,000 | $275,000 |
| SUBCONTRACTOR PROFIT | 10.0% | $27,500 | $302,500 |

| MILLWORK CONTRACTOR SUBTOTAL |
|---|
| $302,500 |

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## FIRE PROTECTION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL | | |
| CONTRACTOR: | FIRE PROTECTION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| Pre-Action Fire Sprinkler System | 1,500 | sf | $5 | $7,200 | | | | $7,200 |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$7,200** | | | | **$7,200** |

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## FIRE PROTECTION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL | | |
| CONTRACTOR: | FIRE PROTECTION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$7,200

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $720 | $7,920 |
| SUBCONTRACTOR PROFIT | 10.0% | $792 | $8,712 |

| FIRE PROTECTION CONTRACTOR SUBTOTAL |
|---|
| **$8,712** |

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# MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| Energy Labs - Custom Air Handling Unit | 1 | ea | $23,000 | $23,000 | $5,700 | $5,700 | | $28,700 |
| Scientific Climate Systems - Turnkey Cooler and Freezer | 1 | ls | | | | | | $450,000 |
| | | | | | | | | |
| Ductwork | 2,000 | lbs | $0.69 | $1,380 | $4.77 | $9,540.00 | | $10,920 |
| Insulation | 800 | sf | $0.21 | $168 | $2.20 | $1,760.00 | | $1,928 |
| | | | | | | | | |
| Steam Piping | 200 | lf | | | $44 | $8,800 | | $8,800 |
| Steam Condensate Piping | 200 | lf | | | $30 | $6,000 | | $6,000 |
| | | | | | | | | |
| Chilled Water Piping | 400 | lf | | | $128 | $51,200 | | $51,200 |
| | | | | | | | | |
| Controls | 36 | pt | | | $1,000 | $36,000 | | $36,000 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | **$24,548** | | **$119,000** | | **$593,548** |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |

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# MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mechanical Demolition | | | | | | | | |
| Existing Multizone Ductwork | 150 | lf | | | $46 | $6,900 | | $6,900 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | **$6,900** | | **$6,900** |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
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# MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | | | |

WORKSHEET SUBTOTAL
$600,448

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $60,045 | $660,493 |
| SUBCONTRACTOR PROFIT | 10.0% | $66,049 | $726,542 |

| HVAC CONTRACTOR SUBTOTAL |
|---|
| $726,542 |

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## MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

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# TESTING, ADJUSTING, & BALANCING COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL- Single new Chiller Primary/ Secondary | | |
| CONTRACTOR: | TAB | | |
| COMPUTED BY: | J. Hughes | | |
| CHECKED BY: | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| [INSERT CATEGORY] | | | | | | | | |
| Air and Water Testing, Adjusting and Balancing | 1 | ls | | | | | | $11,000 |
| | | | | | | | | |
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| | | | | | | | | |
| [INSERT CATEGORY] SUBTOTAL | | | | | | $749 | | $11,749 |

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# TESTING, ADJUSTING, & BALANCING COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL- Single new Chiller Primary/ Secondary | | |
| CONTRACTOR: | TAB | | |
| COMPUTED BY: | J. Hughes | | |
| CHECKED BY: | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$11,749

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,175 | $12,924 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,292 | $14,216 |

| TAB CONTRACTOR SUBTOTAL |
|---|
| **$14,216** |

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# FIRE ALARM COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | TECHNOLOGIES | | |
| CONTRACTOR: | FIRE ALARM | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Branch Circuitry - Fire Alarm | 300 | l.f. | $2 | $500 | $7 | $2,106 | | $2,606 |
| Smoke Detector - Duct Mounted | 2 | ea | $384 | $768 | $155 | $310 | | $1,078 |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$1,268** | | **$2,416** | | **$3,684** |

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## FIRE ALARM COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 1 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | TECHNOLOGIES | | |
| CONTRACTOR: | FIRE ALARM | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$3,684

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $368 | $4,052 |
| SUBCONTRACTOR PROFIT | 10.0% | $405 | $4,458 |

| FIRE ALARM CONTRACTOR SUBTOTAL |
|---|
| **$4,458** |

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# COST ESTIMATE SUMMARY

| | |
|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 |
| PROJ.No.: | 1464.1 |
| DATE: | 08/23/16 |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- ☐ CODE A ( No design completed)
- ☑ CODE B (Preliminary design)
- ☐ CODE C (Finished design)
- ☐ OTHER (Change Order)

| GENERAL CONTRACTOR | | |
|---|---|---|
| **Div.** | **Subcontractor** | **Subtotal** |
| 01 | Gen. Req. | $8,869 |
| 02 | Demolition | $12,100 |
| 03 | Interior Concrete | $9,638 |
| 04 | Masonry | $0 |
| 05 | Metal Work | $21,871 |
| 07 | Roofing | $0 |
| 08 | Doors/Hardware | $7,865 |
| 08 | Glazing | $0 |
| 09 | Carpeting | $0 |
| 09 | Ceiling | $0 |
| 09 | Framing/Drywall | $9,741 |
| 09 | Painting | $18,150 |
| 09 | Tile Work | $0 |
| 10 | Toilet Accessories | $0 |
| 12 | Millwork | $484,000 |
| | | |
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| GENERAL CONTRACTOR (CONT.) | | |
|---|---|---|
| **Div.** | **Subcontractor** | **Subtotal** |
| 21 | Fire Protection | $11,616 |
| 22 | Plumbing | $0 |
| 23 | Mechanical | $748,958 |
| 26 | Electrical | $40,737 |
| 28 | Fire Alarm | $4,458 |
| 31 | Earthwork | $0 |
| 33 | UG Utilities | $0 |
| 27 | Telecomm | $0 |
| | Access/Security | $0 |
| | | |
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| | | |
| *Subtotal* | | *$1,378,002* |
| Subcontractor Supervision | | 0.0% |
| | | *$0* |
| GC Direct Costs | | |
| **GC Subtotal** | | **$1,378,002** |

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| Owner Contingency | 5.0% | $68,900 | $1,446,902 |
| General Contractor Contingency | 5.0% | $68,900 | $1,515,802 |
| General Contractor Liability | 1.0% | $15,158 | $1,530,960 |
| General Contractor Bond | 1.8% | $27,284 | $1,558,244 |
| General Contractor Overhead | 10.0% | $155,824 | $1,714,069 |
| General Contractor Profit | 5.0% | $85,703 | $1,799,772 |
| General Contractor Tax | 7.2% | $128,684 | $1,928,456 |

***TOTAL OPINION OF PROBABLE CONSTRUCTION COST $1,928,456***

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# COST ESTIMATE SUMMARY

| | |
|---|---|
| **PROJECT:** | ASM PHOTO ARCHIVE OPT. 2 |
| **PROJ.No.:** | 1464.1 |
| **DATE:** | 08/23/16 |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- ☐ CODE A ( No design completed)
- ☑ CODE B (Preliminary design)
- ☐ CODE C (Finished design)
- ☐ OTHER (Change Order)

**GENERAL SUMMARY OF WORK:**

**LIST OF ASSUMPTIONS:**

This estimate is based on a conceptual design prior to the generation of documents.

This estimate does not include A/E fees, FF&E, Owner Management, or Project costs not explicitly state.

All work is to be performed under a single contract.

All work will be competitively bid as a the Design-Bid-Build project.

No significant escalation will occur for the duration of this project.

No special restrictions will occur during construction.

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# COST ESTIMATE SUMMARY

| | |
|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 |
| PROJ.No.: | 1464.1 |
| DATE: | 08/23/16 |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- ☐ CODE A ( No design completed)
- ☑ CODE B (Preliminary design)
- ☐ CODE C (Finished design)
- ☐ OTHER (Change Order)

| MECHANICAL SUBCONTRACTOR | |
|---|---|
| **Second Tier Subcontractor** | **Subtotal** |
| Controls | $0 |
| TAB | $14,216 |
| *Subtotal* | *$14,216* |
| Second Tier Sub Supervision | 3.0% |
| | *$426* |
| Mechanical Direct Costs | *$734,315* |
| **Total Mechanical Cost** | **$748,958** |

| ELECTRICAL SUBCONTRACTOR | |
|---|---|
| **Second Tier Subcontractor** | **Subtotal** |
| Telecommunications | $0 |
| | |
| *Subtotal* | *$0* |
| Second Tier Sub Supervision | 3.0% |
| | *$0* |
| Electrical Direct Costs | *$40,737* |
| **Total Electrical Cost** | **$40,737** |

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# GENERAL REQUIREMENTS COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | GENERAL REQUIREMENTS | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| | | | | | | | | |
| Rough Carpentry | 1 | LS | | | | | | $2,000 |
| Dumpster Rental 40 Cubic Yards- Weekly Rental | 5 | per day | $930 | $4,650 | | | | $4,650 |
| Hauling, Dump, Return. | 6 | | $30 | $180 | | | | $180 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Site Construction SUBTOTAL** | | | | **$4,830** | | | **$16** | **$7,330** |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
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## GENERAL REQUIREMENTS COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | GENERAL REQUIREMENTS | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **[INSERT CATEGORY] SUBTOTAL** | | | | | | |

WORKSHEET SUBTOTAL
$7,330

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $733 | $8,063 |
| SUBCONTRACTOR PROFIT | 10.0% | $806 | $8,869 |

| GENERAL REQUIREMENTS CONTRACTOR SUBTOTAL |
|---|
| **$8,869** |

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# DEMOLITION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DEMOLITION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$10,000

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,000 | $11,000 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,100 | $12,100 |

| DEMOLITION CONTRACTOR SUBTOTAL |
|---|
| **$12,100** |

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# INTERIOR CONCRETE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | INTERIOR CONCRETE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Mechanical Mezzanine** | | | | | | | | |
| Concrete | 30 | CY | $166 | $4,968 | $98 | $2,952 | $1.50 | $7,965 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | **$4,968** | | **$2,952** | **$2** | **$7,965** |

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## INTERIOR CONCRETE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | INTERIOR CONCRETE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$7,965

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $797 | $8,762 |
| SUBCONTRACTOR PROFIT | 10.0% | $876 | $9,638 |

| INTERIOR CONCRETE CONTRACTOR SUBTOTAL |
|---|
| $9,638 |

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## METAL WORK COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | METAL WORK | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Mechanical Mezzanine** | | | | | | | | |
| Steel | 1,500 | SF | $6 | $9,000 | $6 | $9,000 | $0.05 | $18,075 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | **$9,000** | | **$9,000** | **$0** | **$18,075** |

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## METAL WORK COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | METAL WORK | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$18,075

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,808 | $19,883 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,988 | $21,871 |

| METAL WORK CONTRACTOR SUBTOTAL |
|---|
| **$21,871** |

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# DOORS & HARDWARE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DOORS & HARDWARE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Door/Frames** | | | | | | | | |
| Single man Door | 2 | EA | | | | | | $1,200 |
| Double Man Door | 1 | EA | | | | | | $3,800 |
| Exterior Wall Louver | 1 | EA | | | | | | $1,500 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | | | **$6,500** |

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## DOORS & HARDWARE COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | DOORS & HARDWARE | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$6,500

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $650 | $7,150 |
| SUBCONTRACTOR PROFIT | 10.0% | $715 | $7,865 |

**DOORS & HARDWARE CONTRACTOR SUBTOTAL**
**$7,865**

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# PAINTING COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | PAINTING | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Painting** | 5,000 | SF | $1 | $5,000 | $2.00 | $10,000 | | $15,000 |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$5,000** | | **$10,000** | | **$15,000** |

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## PAINTING COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | PAINTING | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$15,000

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,500 | $16,500 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,650 | $18,150 |

| PAINTING CONTRACTOR SUBTOTAL |
|---|
| **$18,150** |

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## FRAMING & DRYWALL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | FRAMING & DRYWALL | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| **Mechanical Mezzanine** | | | | | | | | |
| Wall Framing, Drywall, Paint | 1,000 | SF | $4 | $4,000 | $4 | $4,000 | $0.05 | $8,050 |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$4,000** | | **$4,000** | **$0** | **$8,050** |

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## FRAMING & DRYWALL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | FRAMING & DRYWALL | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$8,050

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $805 | $8,855 |
| SUBCONTRACTOR PROFIT | 10.0% | $886 | $9,741 |

| FRAMING & DRYWALL CONTRACTOR SUBTOTAL |
|---|
| $9,741 |

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# MILLWORK COST ESTIMATE

| | | | |
|---|---|---|---|
| **PROJECT:** | ASM PHOTO ARCHIVE OPT. 2 | **PROJ.No.:** | 1464.1 |
| | | **DATE:** | 08/23/16 |
| **DEPARTMENT:** | ARCHITECTURE | | |
| **CONTRACTOR:** | MILLWORK | | |
| **COMPUTED BY:** | [ABC] | | |
| **CHECKED BY:** | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| Movable Shelving - Dual Level 33,840 Archive Boxes Delivered and Installed | 1 | LS | | | | | | $400,000 |

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## MILLWORK COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ARCHITECTURE | | |
| CONTRACTOR: | MILLWORK | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| [INSERT CATEGORY] SUBTOTAL | | | | | |
|---|---|---|---|---|---|

WORKSHEET SUBTOTAL
$400,000

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $40,000 | $440,000 |
| SUBCONTRACTOR PROFIT | 10.0% | $44,000 | $484,000 |

| MILLWORK CONTRACTOR SUBTOTAL |
|---|
| $484,000 |

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# FIRE PROTECTION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL | | |
| CONTRACTOR: | FIRE PROTECTION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| Pre-Action Fire Sprinkler System | 2,000 | sf | $5 | $9,600 | | | | $9,600 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | **$9,600** | | | | **$9,600** |

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## FIRE PROTECTION COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL | | |
| CONTRACTOR: | FIRE PROTECTION | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$9,600

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $960 | $10,560 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,056 | $11,616 |

| FIRE PROTECTION CONTRACTOR SUBTOTAL |
|---|
| **$11,616** |

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# MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| [INSERT CATEGORY] | | | | | | | | |
| Energy Labs - Custom Air Handling Unit | 1 | ea | $23,000 | $23,000 | $5,700 | $5,700 | | $28,700 |
| Scientific Climate Systems - Turnkey Cooler and Freezer | 1 | ls | | | | | | $450,000 |
| | | | | | | | | |
| Ductwork | 3,000 | lbs | $0.69 | $2,070 | $4.77 | $14,310.00 | | $16,380 |
| Insulation | 1,200 | sf | $0.21 | $252 | $2.20 | $2,640.00 | | $2,892 |
| | | | | | | | | |
| Steam Piping | 200 | lf | | | $44 | $8,800 | | $8,800 |
| Steam Condensate Piping | 200 | lf | | | $30 | $6,000 | | $6,000 |
| | | | | | | | | |
| Chilled Water Piping | 400 | lf | | | $128 | $51,200 | | $51,200 |
| | | | | | | | | |
| Controls | 36 | pt | | | $1,000 | $36,000 | | $36,000 |
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| [INSERT CATEGORY] SUBTOTAL | | | | $25,322 | | $124,650 | | $599,972 |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| [INSERT CATEGORY] | | | | | | | | |

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# MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mechanical Demolition | | | | | | | | |
| Existing Multizone Ductwork | 150 | lf | | | $46 | $6,900 | | $6,900 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | **$6,900** | | **$6,900** |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
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# MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | | | |

WORKSHEET SUBTOTAL
$606,872

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $60,687 | $667,559 |
| SUBCONTRACTOR PROFIT | 10.0% | $66,756 | $734,315 |

| HVAC CONTRACTOR SUBTOTAL |
|---|
| $734,315 |

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## MECHANICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL - Single new Chiller Primary/ Secondary New Bay | | |
| CONTRACTOR: | HVAC | | |
| COMPUTED BY: | Doug Stingelin | | |
| CHECKED BY: | Doug Stingelin | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

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# TESTING, ADJUSTING, & BALANCING COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL- Single new Chiller Primary/ Secondary | | |
| CONTRACTOR: | TAB | | |
| COMPUTED BY: | J. Hughes | | |
| CHECKED BY: | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| Air and Water Testing, Adjusting and Balancing | 1 | ls | | | | | | $11,000 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | | | **$749** | | **$11,749** |

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## TESTING, ADJUSTING, & BALANCING COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | MECHANICAL- Single new Chiller Primary/ Secondary | | |
| CONTRACTOR: | TAB | | |
| COMPUTED BY: | J. Hughes | | |
| CHECKED BY: | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

WORKSHEET SUBTOTAL
$11,749

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $1,175 | $12,924 |
| SUBCONTRACTOR PROFIT | 10.0% | $1,292 | $14,216 |

| TAB CONTRACTOR SUBTOTAL |
|---|
| **$14,216** |

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# ELECTRICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ELECTRICAL - Single new Chiller Primary/ Secondary | | |
| CONTRACTOR: | ELECTRICAL | | |
| COMPUTED BY: | J. Hughes | | |
| CHECKED BY: | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| [INSERT CATEGORY] | | | | | | | | |
| | | | | | | | | |
| Circuit Breaker - 200A | 1 | ea | $1,175 | $1,175 | $129 | $129 | | $1,304 |
| Panel Feeder - 200A | 200 | l.f. | $27 | $5,400 | $24 | $4,700 | | $10,100 |
| Panel Board - 200A | 1 | ea | $2,350 | $2,350 | $1,475 | $1,475 | | $3,825 |
| Branch Circuitry - 20A | 600 | l.f. | $1 | $834 | $6 | $3,510 | | $4,344 |
| Branch Circuitry - 30A | 100 | l.f. | $2 | $221 | $7 | $720 | | $941 |
| Branch Circuitry - 45A | 100 | l.f. | $4 | $360 | $8 | $830 | | $1,190 |
| Combination Motor Starter - 1hp | 3 | ea | $203 | $609 | $118 | $354 | | $963 |
| Lighting | 1 | ls | | | | | | $6,000 |
| | | | | | | | | |
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| | | | | | | | | |
| [INSERT CATEGORY] SUBTOTAL | | | | $10,949 | | $11,718 | | $28,667 |

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| [INSERT CATEGORY] | | | | | | | | |
| | | | | | | | | |
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## ELECTRICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | ELECTRICAL - Single new Chiller Primary/ Secondary | | |
| CONTRACTOR: | ELECTRICAL | | |
| COMPUTED BY: | J. Hughes | | |
| CHECKED BY: | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Electrical Demo Allowance | 1 | ls | $5,000 | $5,000 | | | | $5,000 |
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| **[INSERT CATEGORY] SUBTOTAL** | | | | **$5,000** | | | | **$5,000** |

WORKSHEET SUBTOTAL
$33,667

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $3,367 | $37,034 |
| SUBCONTRACTOR PROFIT | 10.0% | $3,703 | $40,737 |

| ELECTRICAL CONTRACTOR SUBTOTAL |
|---|
| **$40,737** |

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## ELECTRICAL COST ESTIMATE

| | | | |
|---|---|---|---|
| **PROJECT:** | ASM PHOTO ARCHIVE OPT. 2 | **PROJ.No.:** | 1464.1 |
| | | **DATE:** | 08/23/16 |
| **DEPARTMENT:** | ELECTRICAL - Single new Chiller Primary/ Secondary | | |
| **CONTRACTOR:** | ELECTRICAL | | |
| **COMPUTED BY:** | J. Hughes | | |
| **CHECKED BY:** | J. Hughes | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

GLHN ARCHITECTS & ENGINEERS, INC
2939 E Broadway Blvd | Tucson, AZ 85716
t520.881.4546 | f520.795.1822 | GLHN.com

GLHN

## FIRE ALARM COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | TECHNOLOGIES | | |
| CONTRACTOR: | FIRE ALARM | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

| SUMMARY | QUANTITY | | MATERIAL | | LABOR | | EQUIP | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| | # UNITS | MEAS. | PER UNIT | TOTAL | PER UNIT | TOTAL | PER UNIT | |
| **[INSERT CATEGORY]** | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Branch Circuitry - Fire Alarm | 300 | l.f. | $2 | $500 | $7 | $2,106 | | $2,606 |
| Smoke Detector - Duct Mounted | 2 | ea | $384 | $768 | $155 | $310 | | $1,078 |
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| | | | | | | | | |
| **[INSERT CATEGORY] SUBTOTAL** | | | | **$1,268** | | **$2,416** | | **$3,684** |

GLHN ARCHITECTS & ENGINEERS, INC
2939 E Broadway Blvd | Tucson, AZ 85716
t520.881.4546 | f520.795.1822 | GLHN.com

## FIRE ALARM COST ESTIMATE

| | | | |
|---|---|---|---|
| PROJECT: | ASM PHOTO ARCHIVE OPT. 2 | PROJ.No.: | 1464.1 |
| | | DATE: | 08/23/16 |
| DEPARTMENT: | TECHNOLOGIES | | |
| CONTRACTOR: | FIRE ALARM | | |
| COMPUTED BY: | [ABC] | | |
| CHECKED BY: | [ABC] | | |

**OPINION OF PROBABLE CONSTRUCTION COST**

BASIS FOR ESTIMATE

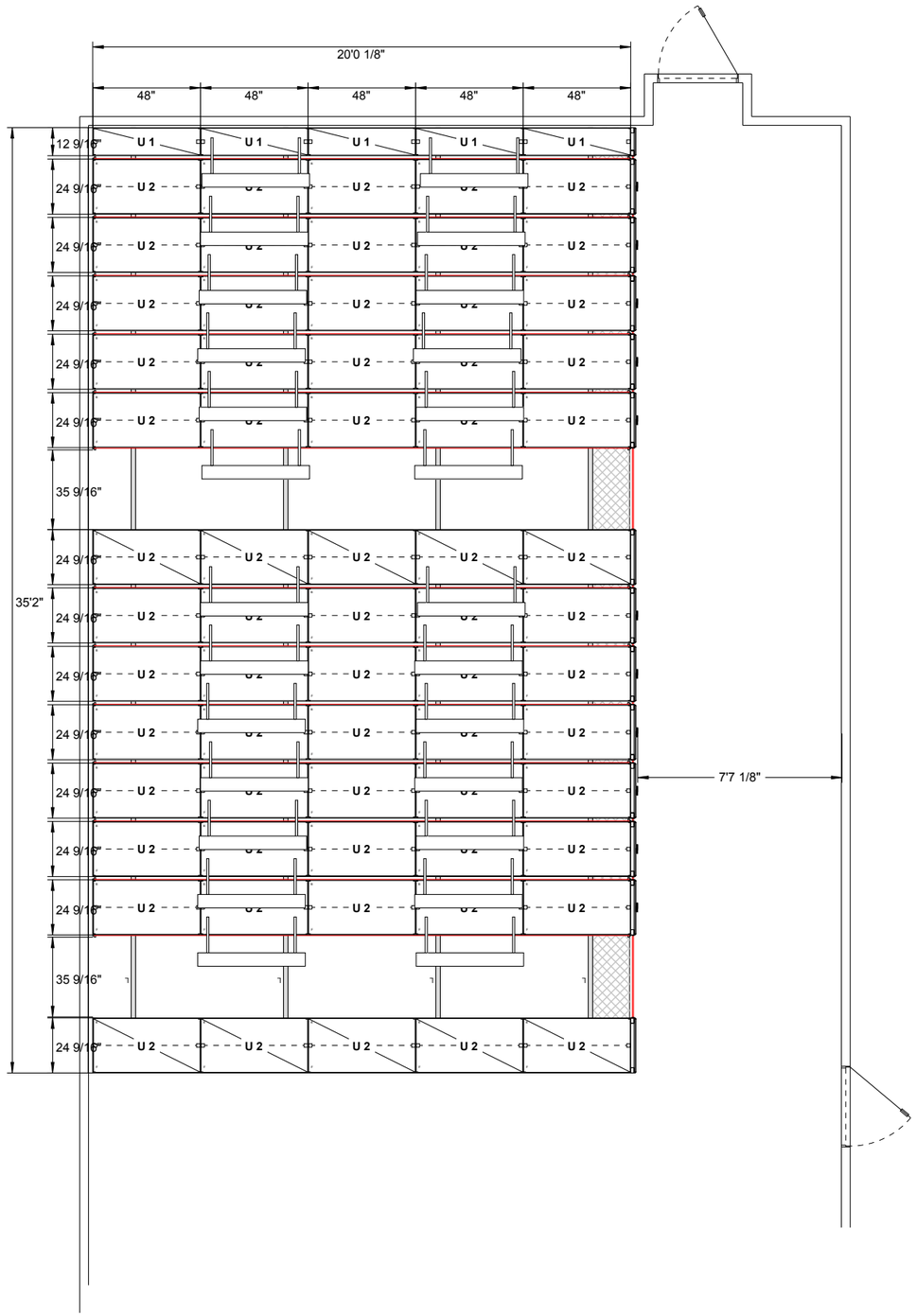
- [x] CODE A ( No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Finished design)
- [ ] OTHER (Change Order)

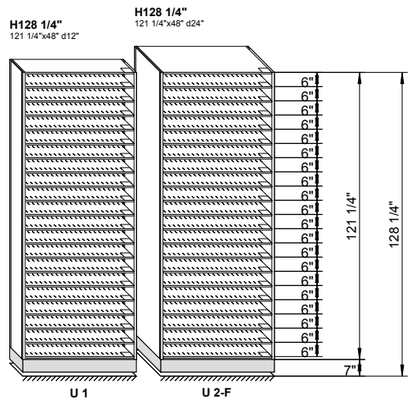
WORKSHEET SUBTOTAL
$3,684

| Markup | Percentage | Cost | Subtotal |
|---|---|---|---|
| SUBCONTRACTOR OVERHEAD | 10.0% | $368 | $4,052 |
| SUBCONTRACTOR PROFIT | 10.0% | $405 | $4,458 |

| FIRE ALARM CONTRACTOR SUBTOTAL |
|---|
| **$4,458** |

Appendix 2 – Movable Storage Cut Sheets and Information




Filing Capacity

Items not assigned to a Position

| | |
|---|---|
| Actual LFI | 124,200" |
| Nominal LFI | 129,600" |
| Actual LFF | 10350'0" |
| Nominal LFF | 10800'0" |

☒ Include Existing

**System Weight Summary Report**

| | | | |
|---|---|---|---|
| Total media weight | 124,200.00 | lbs | |
| Total equipment weight | 40,942.15 | lbs | |
| Total picklist weight | 0.00 | lbs | |
| Total aisle weight (15 lbs/ft²) | 3,382.89 | lbs | |
| Total system (media, equipment and aisle) weight | 168,525.04 | lbs | |
| Total Foot-Print area | 815.78 | ft² | |
| Total weight load per square foot (avg unit load) | 206.58 | lbs/ft² | |
| Maximum Deflection Allowed is: | L/480 | | |
| Weight load (line load*) under front rail | 36,397.07 | lbs | 1,034.99 lbs/ft |
| Weight load (line load*) under rail no. 2 | 45,918.01 | lbs | 1,305.73 lbs/ft |
| Weight load (line load*) under rail no. 3 | 45,918.01 | lbs | 1,305.73 lbs/ft |
| Weight load (line load*) under back rail | 35,185.01 | lbs | 1,000.52 lbs/ft |

*Line Load calculations do not include weight of adjacent static shelving, floor, ramp, or aisles.

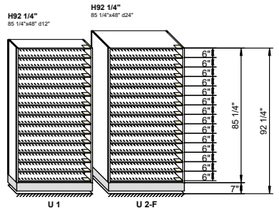
# OPTION ONE

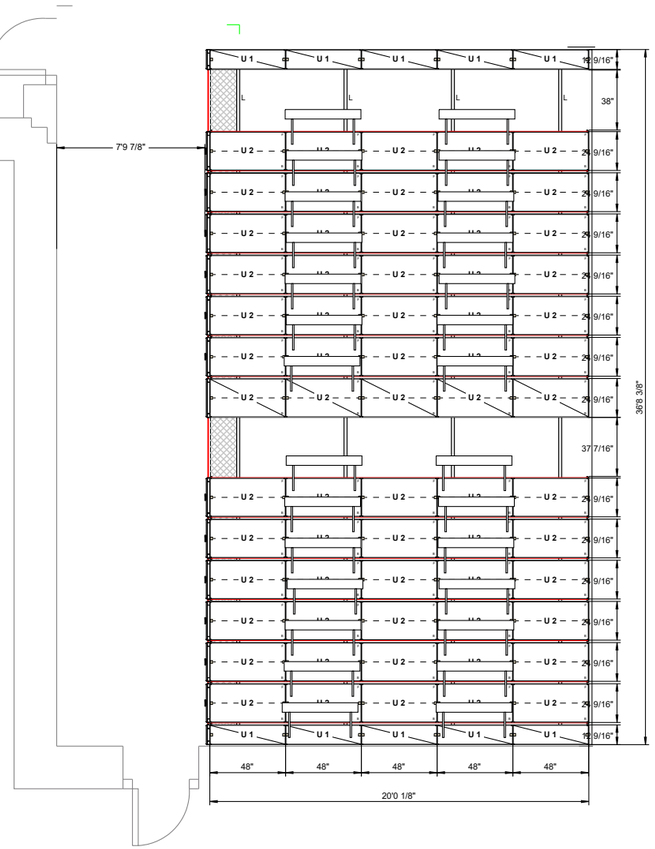
## (21,600) ARCHIVE PHOTO BOXES
## 5 3/4" W, 4 5/8" H, 10 1/2" D

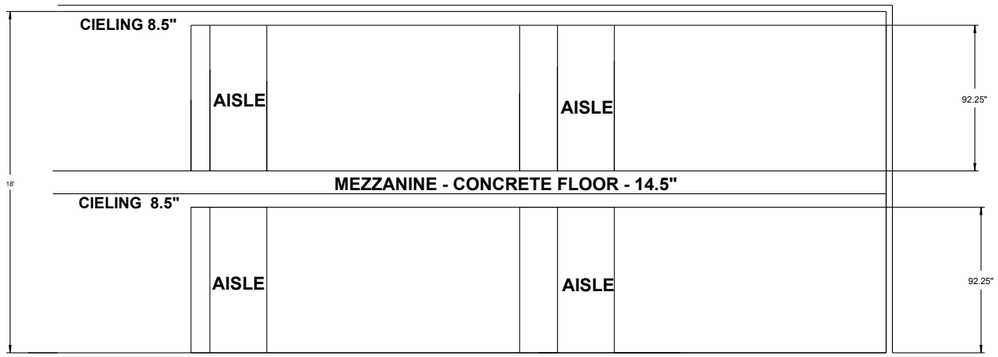
Spacesaver®
Storage Solved®

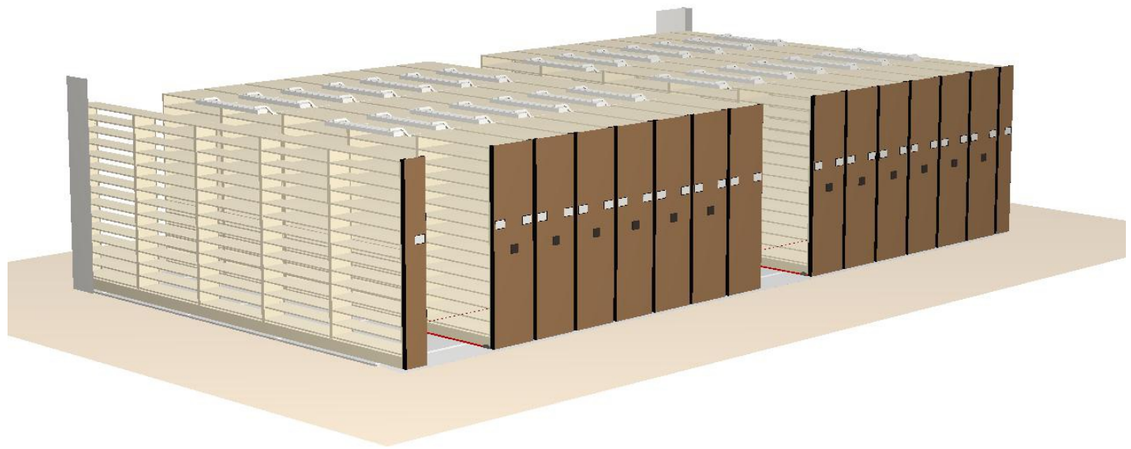
**Rev level:**
**Date Printed: 01/23/2015**
**Last Saved: 01/23/2015**
**Drawn by: Rick Contryman**
**Salesperson:**
**Project Name: ARIZONA STATE MUSEUM - PHOTOGRAPHY COLLECTION**
**Project #: 150-101**
**Scale 3/16" = 1'**

**Spacesaver Corporation**
**1450 Janesville Avenue**
**Fort Atkinson, Wisconsin**
**53538-2798 USA**
**PH: 920-563-6362 FAX: 920-563-2702**
**www.spacesaver.com**



| Filing Capacity | |
|---|---|
| Items not assigned to a Position | |
| Actual LFI | 90,160" |
| Nominal LFI | 94,080" |
| Actual LFF | 7513'4" |
| Nominal LFF | 7840'0" |
| ☒ Include Existing | |

| System Weight Summary Report | |
|---|---|
| Total media weight | 90,160.00 lbs |
| Total equipment weight | 32,978.30 lbs |
| Total picklist weight | 0.00 lbs |
| Total aisle weight (15 lbs/ft²) | 3,560.62 lbs |
| Total system (media, equipment and aisle) weight | 126,698.92 lbs |
| Total Foot-Print area | 851.30 ft² |
| Total weight load per square foot (avg unit load) | 148.83 lbs/ft² |
| Maximum Deflection Allowed is: | L/480 |
| *Line Load calculations do not include weight of adjacent static shelving, floor, ramp, or aisles. | |

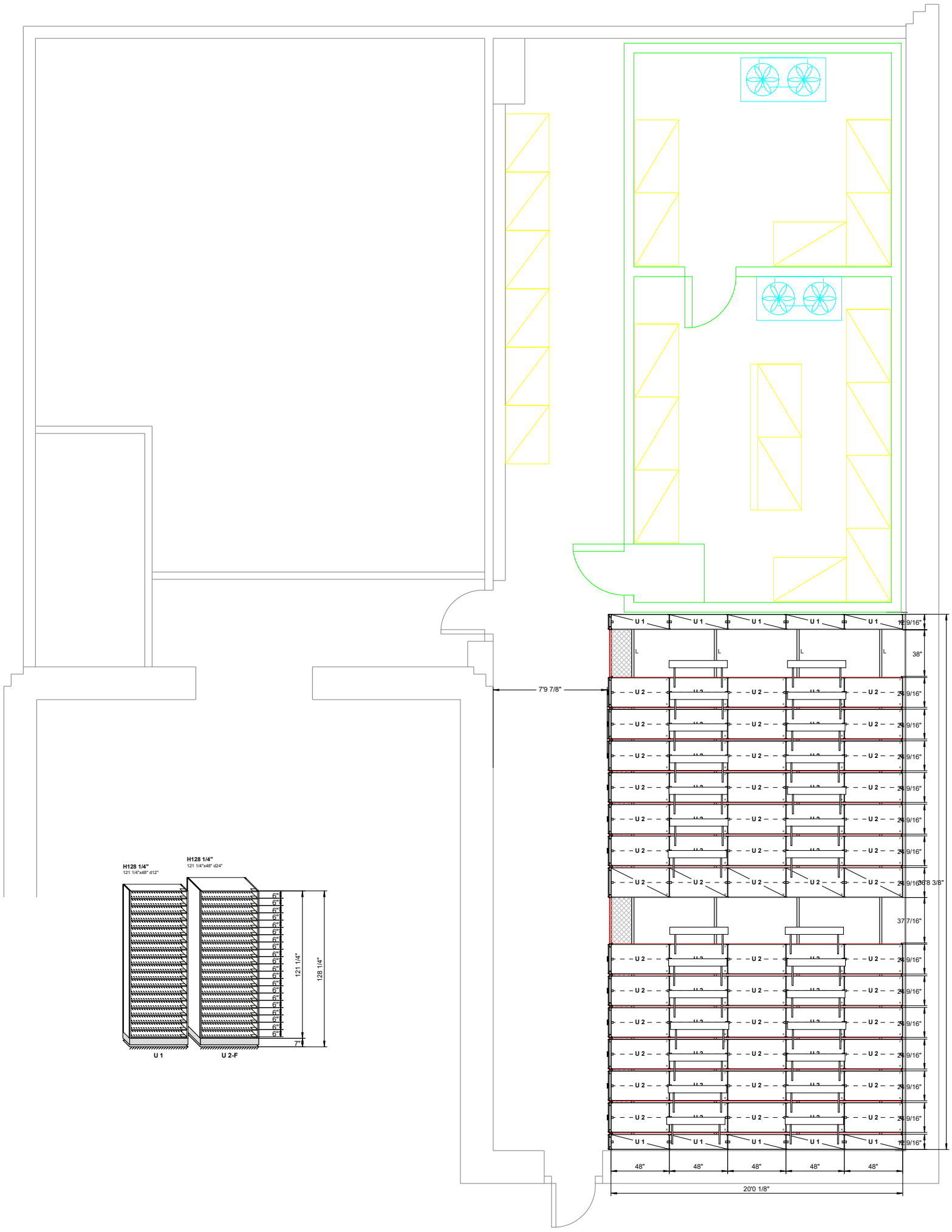
(17,920) ARCHIVE PHOTO BOXES
5 3/4" W, 4 5/8" H, 10 1/2" D

OPTION TWO

Spacesaver
Storage Solved®

**Rev level:**
**Date Printed: 07/26/2016**
**Last Saved: 07/26/2016**
**Drawn by: Rick Contryman**
**Salesperson:**
**Project Name: ARIZONA STATE MUSEUM - PHOTOGRAPHY COLLECTION**
**Project #: 150-101**
**Scale 1/8" = 1'**

**Spacesaver Corporation**
**1450 Janesville Avenue**
**Fort Atkinson, Wisconsin**
**53538-2798 USA**
**PH: 920-563-6362 FAX: 920-563-2702**
**www.spacesaver.com**







| Filing Capacity | |
|---|---|
| Items not assigned to a Position | |
| Actual LFI | 128,800" |
| Nominal LFI | 134,400" |
| Actual LFF | 10733'4" |
| Nominal LFF | 11200'0" |
| ☒ Include Existing | |

| System Weight Summary Report | |
|---|---|
| Total media weight | 128,800.00 lbs |
| Total equipment weight | 43,038.60 lbs |
| Total picklist weight | 0.00 lbs |
| Total aisle weight (15 lbs/ft²) | 3,560.62 lbs |
| Total system (media, equipment and aisle) weight | 175,399.22 lbs |
| Total Foot-Print area | 851.30 ft² |
| Total weight load per square foot (avg unit load) | 206.04 lbs/ft² |
| Maximum Deflection Allowed is: | L/480 |
| *Line Load calculations do not include weight of adjacent static shelving, floor, ramp, or aisles. | |

(22,400) ARCHIVE PHOTO BOXES
5 3/4" W, 4 5/8" H, 10 1/2" D

OPTION ONE

Spacesaver®
Storage Solved®

**Rev level:**
**Date Printed: 07/26/2016**
**Last Saved: 07/18/2016**
**Drawn by: Rick Contryman**
**Salesperson:**
**Project Name: ARIZONA STATE MUSEUM - PHOTOGRAPHY COLLECTION**
**Project #: 150-101**
**Scale 1/8" = 1'**

**Spacesaver Corporation**
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**53538-2798 USA**
**PH: 920-563-6362 FAX: 920-563-2702**
**www.spacesaver.com**

Appendix 3 – Energy Labs Custom Air Handling Unit for Room 328

Air Handling Equipment

# Submittal

# ASM PHOTOGRAPHIC ARCHIVE


Energy Labs Inc

1695 Cactus Road
San Diego CA 92154
Ph. 619) 671 0100
Fax. 619) 671 0160

| | |
|---|---|
| **Sales Agency** | CAS<br>1842 W Grant Rd., Suite H101<br>Tucson, AZ |
| **Sales Agent** | Tom McGreal |
| Energy Labs: | |
| **Job Number** | 0 |
| **Sales Engineer** | Bill Willems |
| **Revision Date** | 8/9/2016 |

# Index



Energy Labs Inc

# Project Summary

# | Project Summary

| Unit Information | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Unit | Supply CFM | Return CFM | Location | Qty | Base Material | Paint | Color | Voltage |
| AH-1 | 2700 | 2700 | Outdoor | 1 | Steel | Polyurethane 3mil | Grey | 460V / 3 Phase |

* To see Cabinet Dimensions and Unit Weight, please refer to Mechanical Drawing.

| Fans | | | | | | | | | | | | | Motor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | Type | Duty | Mfr | Size | Qty | CFM | SP | CL | Fan RPM | Max RPM | BHP | HP | RPM | Manuf. | Type | Eff.(%) | Encl. | Frame Encl. |
| AH-1 | Plenum Fan | Supply | Energy Labs | 135 | 1 | 2700 | 3.5 | 2 | 3141 | 3786 | 2.32 | 3 | 3600 | Reliance | Premium | 86.5 | TEFC | 182T |

| Coils | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Physical Data | | | | | | | | |
| Unit | Duty | Manuf. | Fluid | FH (in) | FL (in) | Qty | Rows | FPI | Fin Mat. | Fin Thickn. | Tube | Conn. Size(in) |
| AH-1 | Chilled Water | Energy Labs | Water | 31.5 | 31 | 1 | 8 | 10 | Aluminum | 0.008 | 0.02 | 1.00 |
| AH-1 | Steam - S | Energy Labs | Steam 0% | 31.5 | 29 | 1 | 1 | 6 | Aluminum | 0.008 | 0.02 | 1.50 |

| Coils (continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Airside performance | | | | | | | | Waterside performance | | | |
| Unit | FV fpm | Capacity - Sens.(BTUH) | Capacity - Total (BTUH) | EAT DB | EAT WB | LAT DB | LAT WB | APD | GPM | EWT | LWT | PD |
| AH-1 | 362 | 59,398 | 70,958 | 72.1 | 59.7 | 49.7 | 49.7 | 0.705 | 10.13 | 44 | 58 | 5.69 |
| AH-1 | 393 | | 106,214 | 63.9 | | 103.3 | | 0.06 | | | | |

| Filters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Unit | Manuf. | Type | Efficiency | Face Area (Sqft) | FV | Size/Qty | Depth (in) | Class |
| AH-1 | Flanders | Prepleat 40 LPD | 30% - MERV 8 | 6 | 450 | 24x24(1), 12x24(1) | 2 | 2 |
| AH-1 | Flanders | Rigid Air | 85% - MERV 13 | 6 | 450 | 24x24(1), 12x24(1) | 12 | 2 |

# Unit Information

# Unit Construction

| | | | |
|---|---|---|---|
| Casing/Roof Material: | 20GA. GALVANNEAL/20GA. GALVANNEAL | Roof Curb: | NO |
| Bolt Material: | STANDARD - ZINC | Washdown Walls: | NO |
| Floor Insulation: | 2IN. FOAM (R=14.2) | ETL Approved: | YES |
| Floor Paint: | NONE | OSHPD Certified: | NO |
| Cont. Welded: | NO | Alcohol Wipe: | NO |
| 2” Upturned Lip: | NO | Shrink Wrap: | NO |
| Altitude: | 2500 | | |

| | Walls/Roof | | | | | Floor | |
|---|---|---|---|---|---|---|---|
| Section | Insulation | Liner Mat. | Liner Type | Thermal B. | Mylar | Material | Liner Mat |
| Plenum-1 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |
| Filter-1 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |
| Coil-1 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |
| Plenum-4 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |
| Coil-2 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |
| Plenum-3 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |
| Plenum Fan-1 | 2" Foam (R12.1) | 20ga. Galv Bright | Solid | No | No | 14ga. Galv Bright | 20ga. Galv Bright |

| | Openings | | | | |
|---|---|---|---|---|---|
| Section | Tag | Louver | Rain Hood | Birdscreen | Walkway grating |
| Plenum-1 | RA-1 | None | None | No | None |
| Plenum-1 | OA-1 | None | None | No | None |
| Plenum-4 | F&B | None | None | No | None |
| Plenum-4 | BP | None | None | No | None |
| Plenum Fan-1 | SA-1 | None | None | No | None |

* To see Opening Sizes, please refer to Mechanical Drawing.

| | Dampers | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Actuator | | | | | |
| Section | Tag | Damper type | Linkage | Vertical Blades | Manuf. | Model | Type | Fail Position | Signal | Locking Quadrant |
| Plenum-1 | RA-1 | Ultra LL\Alum\AF | Opposed | No | | | None | N/A | N/A | No |
| Plenum-1 | OA-1 | Ultra LL\Alum\AF | Opposed | No | | | None | N/A | N/A | No |
| Plenum-4 | F&B | Ultra LL\Alum\AF | Opposed | No | | | None | N/A | N/A | No |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plenum-4 | BP | Ultra LL\Alum\AF | Opposed | No | | | None | N/A | N/A | No |

* To see Opening Sizes, please refer to Mechanical Drawing.

| | Internal Walls | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Section | Type | Size (sqft) | Panel Mat. | Insulation | Gypsum | Liner Mat | Mylar | Perf |
| Plenum-4 | Blank-Off | 11.08 | 16ga. Galv Bright | 2in. - 1 1/2 lbs Fiberglass (R=7.1) | None | None | No | No |

| | Doors | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Section | Type | Location | Height | Width | Window | Lockable Handle | Switch | Ventlock |
| Plenum-1 | Model F | Near | 29 | 19 | No | No | No | No |
| Coil-1 | Model F | Near | 29 | 15 | No | No | No | No |
| Plenum-3 | Model F | Near | 29 | 15 | No | No | No | No |
| Plenum Fan-1 | Model F | Near | 29 | 24 | No | No | Yes | No |

# | Electrical

**UNIT POWER**

| | |
|---|---|
| Unit Voltage: | 460V / 3 PHASE |
| Unit Power: | SINGLE DISCONNECT |
| Unit Disconnect: | NON-FUSED |
| Unit SCCR: | 25KA |

**LIGHTS AND RECEPTACLES**

| | |
|---|---|
| 120V, Lights, GFI's Power: | OTHERS |
| Switched By Unit Disconnect: | NO |
| 120V Disconnect: | NO |

***All components wired to Single Point Power with a Main Unit Disconnect (unless otherwise noted).***

## Lights |

| Lights | Switches |
|---|---|
| **Type** | **Type** |
| **Marine w/Fluorescent Light** | **Standard** |

*For location of lights please refer to the mechanical drawing.

## VFDs |

| Section | Qty | HP | Manuf. | Wire motors to | Options | Supplied by | Installed by | Mounting | Encl. rating |
|---|---|---|---|---|---|---|---|---|---|
| Plenum Fan-1 | 1 | 2 | ABB | Wire to VFD | Bare Drive | Energy Labs | Energy Labs | Energy Labs Enclosure | UL Type 3R |

# Section Options

## PLENUM-1

| | | | |
|---|---|---|---|
| Drain Pan Material: | None | Pressure Switch: | None |
| Pressure Gauge: | None | Gauge/Switch Qty: | 0 |
| | | Floor drains: | None |

## FILTER-1

| | | | |
|---|---|---|---|
| Loading Direction: | Upstream | Blank-off Material: | 16ga. Galv Bright |
| Filters By: | Energy Labs | Filter Style: | Box Style |
| Frames and Clips By: | Energy Labs | Filter Seal : | N/A |
| Frame Material: | Galvaneal | | |

| **Prefilters** | | **Final filters** | |
|---|---|---|---|
| Filter Gauge: | None | Filter Gauge: | None |
| Diff. Pressure Switch: | None | Diff. Pressure Switch: | None |
| Spare Set(s): | 0 | Spare Set(s): | 0 |

## COIL-1

| | | | |
|---|---|---|---|
| Coil Arrangement (HxW): | 1 x 1 | Casing material: | 16ga. 304SS |
| Coil Coating: | None | Pipe chase: | 0” x 0” |
| Coil rack: | None | Pipe Vestibule: | 0” |
| Horizontally staggered: | No | Blank-off material: | 16ga. Galv Bright |
| | | Drain pan material: | 16ga. 304SS |

## PLENUM-4

| | | | |
|---|---|---|---|
| Drain Pan Material: | None | Pressure Switch: | None |
| Pressure Gauge: | None | Gauge/Switch Qty: | 0 |
| | | Floor drains: | None |

## COIL-2

| | | | |
|---|---|---|---|
| Coil Arrangement (HxW): | 1 x 1 | Casing material: | 16ga. Galv Bright |
| Coil Coating: | None | Pipe chase: | 0” x 0” |
| Coil rack: | None | Pipe Vestibule: | 0” |
| Horizontally staggered: | No | Blank-off material: | 16ga. Galv Bright |
| | | Drain pan material: | None |

## PLENUM-3

| | | | |
|---|---|---|---|
| Drain Pan Material: | None | Pressure Switch: | None |
| Pressure Gauge: | None | Gauge/Switch Qty: | 0 |
| | | Floor drains: | None |

## PLENUM FAN-1

| | | | |
|---|---|---|---|
| Drive Type: | Direct-Drive | Inertia Base: | No |
| Wheel Type: | ELPF-ALUM | Extra Set of Belts: | No |
| Arrangement: | 4 | Stainless Steel Shaft: | No |
| Spring defl.w/seismic restraint | 2 in | Fan Flex: | Steel |
| Motor Voltage: | 460V/3Ph/60Hz | Flow Measuring: | Yes w/Veltron DPT 2500 transmitter |
| Shaft Grounding: | Yes | Flow Trac Qty: | One device per fan indicating individual CFM |
| Backdraft Damper: | No | Extended Lube Line: | None |
| Inlet Screen: | None | Motor Removal Rail: | No |
| Fan Guard: | None | 3-Mil Epoxy Paint: | No |
| Belt Guard: | None | Floor Drains: | None |
| Motor Wiring: | Wire To Vfd | Fan Wall Material: | 16ga. Galv Bright |
| Blank-Off Plates: | None | | |

# Cabinet Pressure Drop Report

| Section Type | Calculated PD | PD Override | Comments | Total |
|---|---|---|---|---|
| Plenum-1 (Tag: OA-1) | 0.255 | | P.D. Damper. P.D. for Unducted entrance included | 0.255 |
| Filter-1 (Pre) | 0.175 | | | 0.430 |
| Filter-1 (Final) | 0.396 | | | 0.826 |
| Coil-1 | 0.705 | | | 1.531 |
| Plenum-4 (Tag: BP) | 0.255 | | P.D. Damper. P.D. for Unducted entrance included | 1.786 |
| Coil-2 | 0.060 | | | 1.846 |

| | |
|---|---|
| **Total Static Pressure Loss:** | 1.846 |
| **Total Fan Static Pressure:** | 3.500 |
| **Available External Static Pressure:** | 1.654 |

NOTE: The pressure losses shown above are based on actual, published test data for coils, dampers, filters, and other components. Pressure loss coefficients for cabinet losses and cabinet effects are based on data published in the 'ASHRAE Handbook of Fundamentals', ASHRAE research papers, 'Fan Engineering, 8th Ed.' and Energy Labs internal test data. Values shown are estimates based on these sources. When there are multiple air paths, data shown is for the worst case.

| FLOW TRAC

**DUTY:** **SUPPLY FAN**
FAN TYPE **SWSI**

| FAN SIZE | CFM | ALTITUDE (FT) | TEMPERATURE (F) |
|---|---|---|---|
| 135 | 2700 | 2500 | 70 |

| | |
|---|---|
| PRESSURE TRANSDUCER BY ENERGY LABS. | YES |

| | |
|---|---|
| Delta P. | 5.61 |
| Density (Lb/Ft^3) | 0.068 |
| Gauge Range. | 0-10 |
| Dwyer 2000 Series Magnehelic Gage. | 2010 |
| Setra Model 264 Pressure Transducer Range. | 0-10 |
| Setra Model 264 Pressure Transducer / Model Number. | 2641-010WD-11-T1-C |
| Flow Coefficient (Fc). | 1140 |

10

$$CFM = Fc \times \sqrt{\Delta P}$$

SUPPLY FAN

Energy Labs Flow Trac® provides a differential pressure measured at the fan inlet cone.
This differential pressure is converted to a 4-20 milliamp output signal that is directly proportional to the differential pressure measured by the Flow Trac®.

Knowing the transmitter range (TR) and the Flow Coefficient (FC) of the Energy Labs fan, the CFM being moved by the fan at any point in time can be calculated.

The standard differential pressure transmitter used by the Energy Labs Flow Trac® is the "Setra" 264 series.

The differential pressure transmitter range (model number) is selected by Energy Labs based on the fan size, operating CFM, and air temperature entering the fan. This model number and associated range is provided as part of the submittal for fans purchased with the Flow Trac® option.

| "Setra" model number | Range (inches of water) | TR |
|---|---|---|
| 2641-005WD-11-T1-C | 0 - 5 | **5** |
| 2641-010WD-11-T1-C | 0 - 10 | **10** |
| 2641-015WD-11-T1-C | 0 - 15 | **15** |
| 2641-025WD-11-T1-C | 0 - 25 | **25** |
| 2641-050WD-11-T1-C | 0 - 50 | **50** |

Every Energy Labs fan has a flow coefficient that can be calculated based on the size of the fan, the elevation of the installation, and the temperature of the air entering the fan.
This flow coefficient (FC) is calculated by Energy Labs and is provided as a part of the submittal for fans purchased with the Flow Trac® option.

| | |
|---|---|
| Fan Size | 135 |
| Elevation | 2500 |
| CFM | 2,700 |
| Temperature | 70 |
| Transmitter Model Number | 2641-010WD-11-T1-C |
| Transmitter Range (TR) | 10 |
| Flow Coefficient (FC) | **1,140** |
| Number of Fans (N) | **1** |

Formulas for calculating differential pressure and CFM for a 4-20 milliamp (ma) output proportional to differential pressure.

Differential Pressure (DP)

**DP = (ma-4) * TR/16**

CFM

**CFM = N * FC * sqrt(DP)**

Table of calculated values
Based on the above TR (transmitter range), FC (flow coefficient), and N (number of fans)

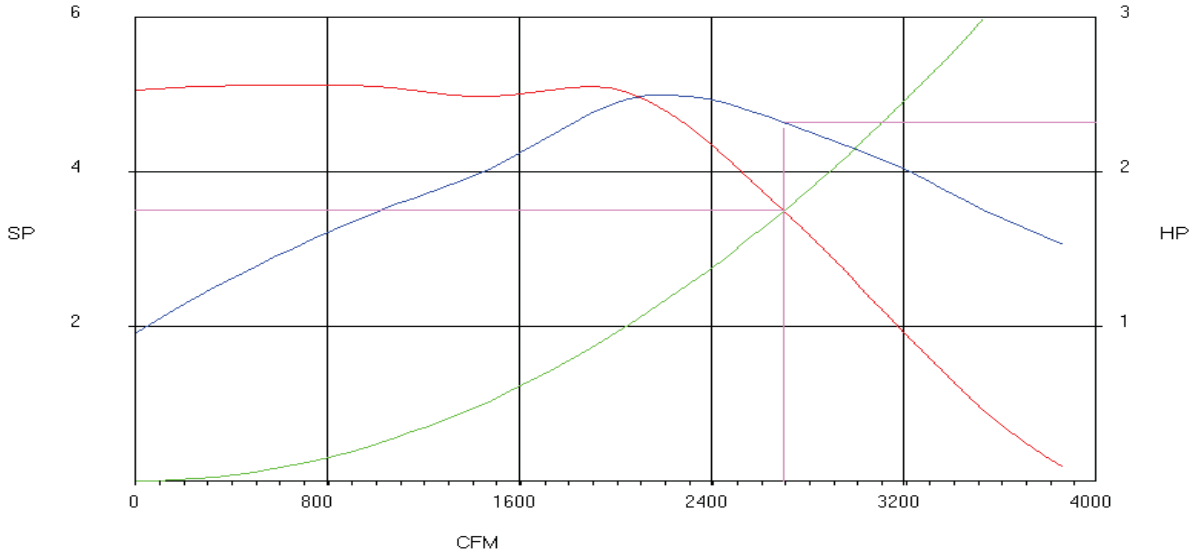
| milliamps (ma) | DP " of water | CFM |
|---|---|---|
| 4 | 0.00 | 0 |
| 5 | 0.63 | 901 |
| 6 | 1.25 | 1,274 |
| 7 | 1.88 | 1,560 |
| 8 | 2.50 | 1,802 |
| 9 | 3.13 | 2,015 |
| 10 | 3.75 | 2,207 |
| 11 | 4.38 | 2,384 |
| 12 | 5.00 | 2,548 |
| 13 | 5.63 | 2,703 |
| 14 | 6.25 | 2,849 |
| 15 | 6.88 | 2,988 |
| 16 | 7.50 | 3,121 |
| 17 | 8.13 | 3,248 |
| 18 | 8.75 | 3,371 |
| 19 | 9.38 | 3,489 |
| 20 | 10.00 | 3,604 |

# Fan Selection Documents

## FAN CURVE

Ver. 6.24 May, 2010

| | | | |
|---|---|---|---|
| Fan Duty: | SUPPLY | Wheel Type: | ELPF-ALUM |
| Fan Size: | 135 | Manufacturer: | ENERGY LABS |
| Fan Model: | PLENUM FAN | Maximum RPM: | 3786 |
| Fan Class: | 2 | Qty of Fans: | 1 |
| Wheel Width: | 100% | | |




| | CFM | SP | BHP | DrHP | RPM | ALT | TEMP | SE |
|---|---|---|---|---|---|---|---|---|
| **Operating:** | 2700 | 3.50 | 2.32 | N/A | 3141 | 2500 | 70 | 64.1 |
| **Standard:** | | 3.84 | 2.54 | | | 0 | 70 | |

| | | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K |
|---|---|---|---|---|---|---|---|---|---|
| **Sound Power:** | **Outlet** | 96 | 87 | 88 | 91 | 89 | 86 | 82 | 81 |
| | **Inlet** | 90 | 80 | 81 | 95 | 81 | 79 | 77 | 71 |

**AMCA International Licensed for Sound and Air Performance**

- Energy Labs Inc. certifies that the model ELPF shown herein is licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311, and comply with the requirements of the AMCA certified ratings program.
- Operating performance and Sound information is for individual fans
- Power rating (BHP) does not include transmission losses.
- Performance ratings do not include the effects of appurtenances (accessories)
- Performance certified is for installation type A: Free inlet, Free outlet
- The sound power level ratings shown are in decibels, referred to 1E-12 watts, calculated per AMCA Standard 301.
- Sound power levels shown are for installation type A: Free inlet, Free outlet
- Only outlet sound power levels (Lwo) are certified in accordance with AMCA 311

# | Coil Selection Documents

## COIL-1

| | | | |
|---|---|---|---|
| Date: | 09/06/2016 | Revision: | 0 |
| Manufacturer: | ENERGY LABS | Coil Altitude [FT]: | 2500 |
| Coil Arrangement (HxW): | 1 X 1 | | |

**COIL GEOMETRY**

| | | | |
|---|---|---|---|
| Type: | CHILLED WATER | No. of Coils: | 1 |
| Construction: | TYPE 'C' - 5/8OD CORR. FIN | No. of Rows: | 8 |
| Fin Height: | 31.5 | No. of Feeds: | 6 |
| Fin Length: | 31 | No. Of Passes: | 28 |
| Fins Per Inch: | 10 | Conn. Size [in]: | 1.00 |
| Fin Thickness: | 0.008 | Conn. Type | MPT |
| Fin Material: | ALUMINUM | Connection Matl: | COPPER |
| Tube Spacing: | 1.5 IN. CENTERS | | |
| Tube Size(OD): | 5/8 | | |
| Tube Wall: | 0.02 | | |

**AIRSIDE DATA:**

| | |
|---|---|
| SCFM: | 2,455 |
| ACFM: | 2,700 |
| Total Capacity [BTUH]: | 70,958 |
| Sensible Cap [BTUH]: | 59,398 |
| Entering DB [DEG F]: | 72.11 |
| Entering WB [DEG F]: | 59.72 |
| Leaving DB [DEG F]: | 49.71 |
| Leaving WB [DEG F]: | 49.67 |
| Std Face Vel [FPM]: | 362 |
| Act Face Vel [FPM:] | 398.2 |
| Pressure Drop [In H2O]: | 0.705 |

**TUBESIDE DATA:**

| | |
|---|---|
| Fluid: | WATER |
| Total GPM(all coils): | 10.13 |
| Ent. Water [DEG F]: | 44 |
| Lvg. Water [DEG F]: | 58.0 |
| Water Vel [FT/SEC]: | 1.91 |
| Press. Drop [FT H2O]: | 5.69 |
| Fluid Fouling Factor [h-ft^2-°F/Btu]: | 0 |

ENERGY LABS PART NO: 5WC-1008-31.5X31-A6/28C

Ver. 4.26 Nov. 2015

NOTES:

- Coil is outside of the scope of AHRI Standard 410.

# COIL-2

| | | | |
|---|---|---|---|
| Date: | 09/06/2016 | Revision: | 0 |
| Manufacturer: | ENERGY LABS | Coil Altitude [FT]: | 2500 |
| Coil Arrangement (HxW): | 1 X 1 | | |

## COIL GEOMETRY

| | | | |
|---|---|---|---|
| Type: | STEAM - S | No. of Coils: | 1 |
| Construction: | TYPE 'C' - 5/8OD CORR. FIN | No. of Rows: | 1 |
| Fin Height: | 31.5 | No. of Feeds: | N/A |
| Fin Length: | 29 | No. Of Passes: | N/A |
| Fins Per Inch: | 6 | Inlet Conn. Size [in]: | 1.50 |
| Fin Thickness: | 0.008 | Outlet Conn. Size [in]: | 1.50 |
| Fin Material: | ALUMINUM | Conn. Type | MPT |
| Tube Spacing: | 1.5 IN. CENTERS | Connection Matl: | COPPER |
| Tube Size(OD): | 5/8 | | |
| Tube Wall: | 0.02 | | |

## AIRSIDE DATA:

| | |
|---|---|
| SCFM: | 2,493 |
| ACFM: | 2,700 |
| Total Capacity [BTUH]: | 106,214 |
| Entering DB [DEG F]: | 63.9 |
| Leaving DB [DEG F]: | 103.34 |
| Std Face Vel [FPM]: | 393 |
| Act Face Vel [FPM]: | 425.6 |
| Pressure Drop [in H2O]: | 0.06 |

## TUBESIDE DATA:

| | |
|---|---|
| Fluid: | STEAM |
| Pressure: | 5 |
| Sat. Temp [DEG F]: | 227.1 |
| Condensate [LBS HR]: | 110.6 |
| Fluid Fouling Factor [h-ft^2-°F/Btu]: | 0 |

ENERGY LABS PART NO: 5SS-0 601-31.5X29-AC

Ver. 4.26 Nov. 2015

NOTES:

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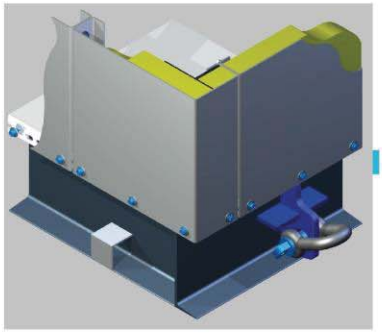
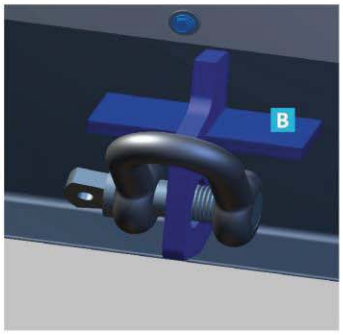
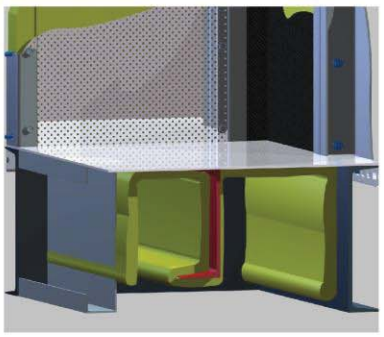
# Section 3

## Construction Details

## 1.1 | Unit base





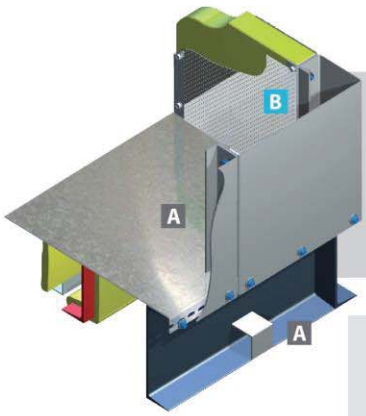
Unit is provided with a continuous welded structural steel channel base, full width heavy gauge formed galvanized steel cross supports are welded in place to provide extra support for interior components. A

Lifting Lugs are incorporated into base. B

There are many types of floors available such as heavier gauge galvanized sheets metal, steel or aluminum diamond tread plate floors, heavy gauge stainless steel floors .

Intermediate structural-steel members are located a critical junctions to further support components such as coils and fans.

## 1.2 | Unit Casing




Unit casing is paint-grip galvanized steel standing seam construction. Each unit is coated as indicated on specification sheet. Panels are individually removable and panels are attached to each other, to the roof, and to the floor with bolts. A

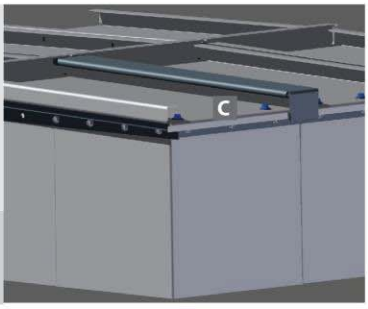
Each panel is pre-punched with CNC machines, caulked and bolted to provide both and air and water-tight seal.

Panels have return break seams, which encapsulae the raw edges of he insulation and ensure cabinet rigidity. B

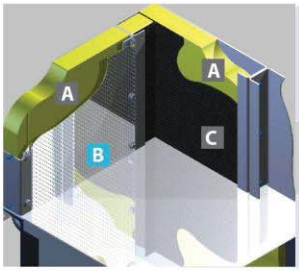
For outdoor units the roof is pitched ¼ In. per foot. Joints are silicone caulked and capped with drive cleats. C

Al roof panels are bolted to wall panel and structural angle, roof penetrations are to the outside of the unit, no bolt penetrations to interior of cabinet.

Unit casings are designed and manufactured for a maximum leakage rate of less than 1%, up to 1.5 times the design static pressure.



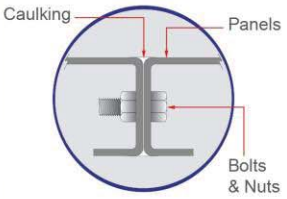
## 1.2.1 | Insulation




All interior surfaces of the walls, and roof are insulated with neoprene coated, NFPA 90A approved insulation, unless otherwise noted in unit data sheet. A

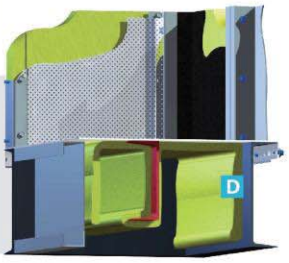
**Tensile strength** Self screws - 50,800 psi
Bolts - 120,000 psi

Solid or perforated Liner material is added to the walls to protect the insulation. B




All raw edges of the insulation are captured by the return break of panels, eliminating exposure of raw fiberglass to the air stream. C

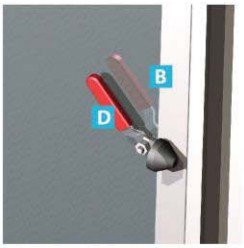
Unit bases are insulated with 2.0" foam as standard. D




Many types of insulation are available upon request.

## 1.3 | Access doors

### Model F Doors



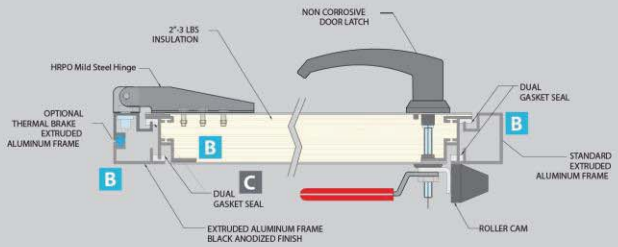

All "F" access doors are manufactured with 16 ga. galvanized painted steel, double wall construction with fully encapsulated insulation. A

The frame is extruded aluminum with an anodized finish. B

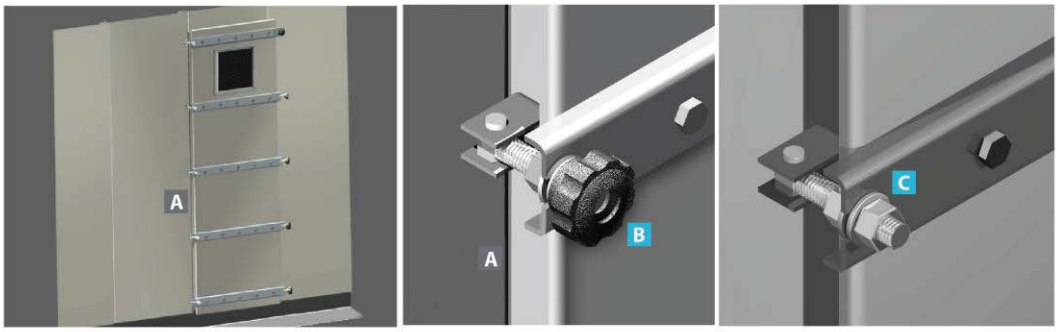
The door utilizes a dual gasket seal system. C

All hardware provided is non-corrosive and all hinges and latches are adjustable. D

Hinges and hardware are 304 stainless steel.



## Model S Doors




All "S" access doors utilize double skin insulated construction. Hinges and locking hardware are adjustable on both right and left side of each door. All doors seal against gasket unitary frames. A

Knurled knobs are provided on access doors to secure door. B

Access door to fan section has bolted hardware C in lieu of knurled knobs, to meet code requirement.

Fully adjustable heavy duty hinges and latches are supplied with non-corrosive hardware.

## 1.4 | Fan and Motor Assembly

1.1.5 Fan and motor assembly units are provided with supply fan and motor spring-isolated assemblies.

Rigid structural steel base frames supported at four (4) points on free floating spring isolators with seismic is flex connected to fan divider wall.

Fan wheels are aluminum, light weight, light weight fan wheels will increase the bearing life of motors.

Blades are airfoil design

Aluminum fan wheels are none corrosive, and spark resistant.

### 1.4.1 | Motors

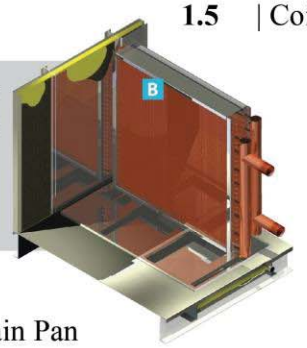
For motor information see motor data sheet in submittals.

## 1.5 | Coils

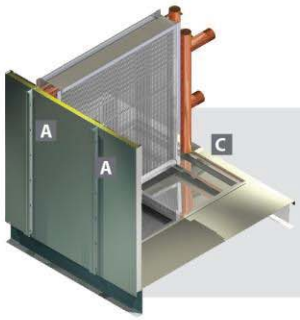
Coils are certified in accordance with A.R.I. Standard #410. Coils are factory tested under water at a minimum of 300 PSIG. Coils have removable panels on at least one side for easy removal. A

Removable panels are located on the opposite side of the coil connection, unless otherwise noted in mechanical drawing. B

Drain pans are sized such that coil return bends and headers are inside the pan. C



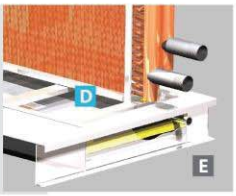

### 1.5.1 | Condensate Drain Pan

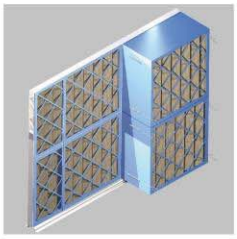



Condensate pans beneath cooling coils are of double skin construction with 1 inch polyurethane foam insulation. D

Pans are constructed of 16 gauge 304 stainless steel, with stainless steel drain connection on one side. E

A galvanized steel cover protects the insulation.



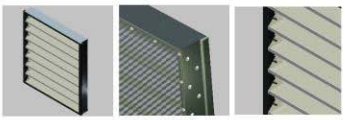



## 1.6 | Filter Section

Filter section has 16 Gauge galvanized steel frame.

Stainless steel frames are available as an option. Filter frame corners are welded to eliminate the possibility of air leaks in frame structure.

## 1.7 | Louvers



Louvers are weatherproof and are protected with bird screens.

Louvers are designed so there is no water penetration below 500 FPM air inlet velocity.

## 1.8 | Dampers

Dampers manufactured by Energy Labs have a 16 gauge galvanized steel frame, damper blades are extruded aluminum, nylon bushings and zinc plated shafts.

Aluminum dampers are light weight to reduce unit weights. Aluminum damper blades are much more resistant to corrosion.

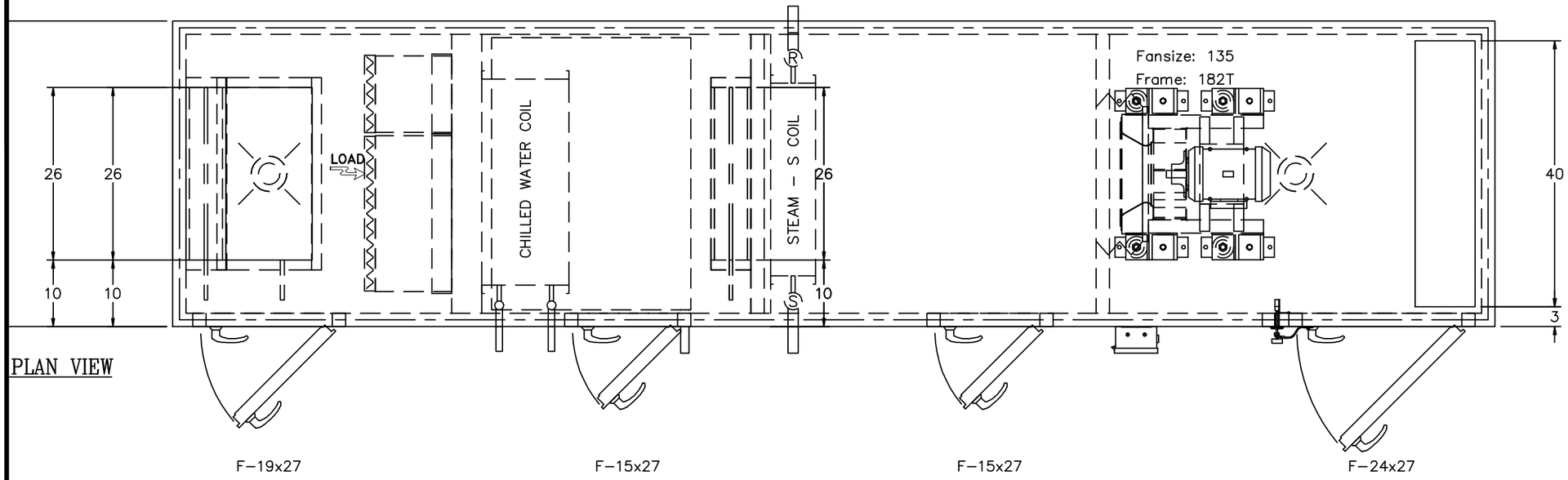
# WARRANTY POLICY

## AIR HANDLER UNIT

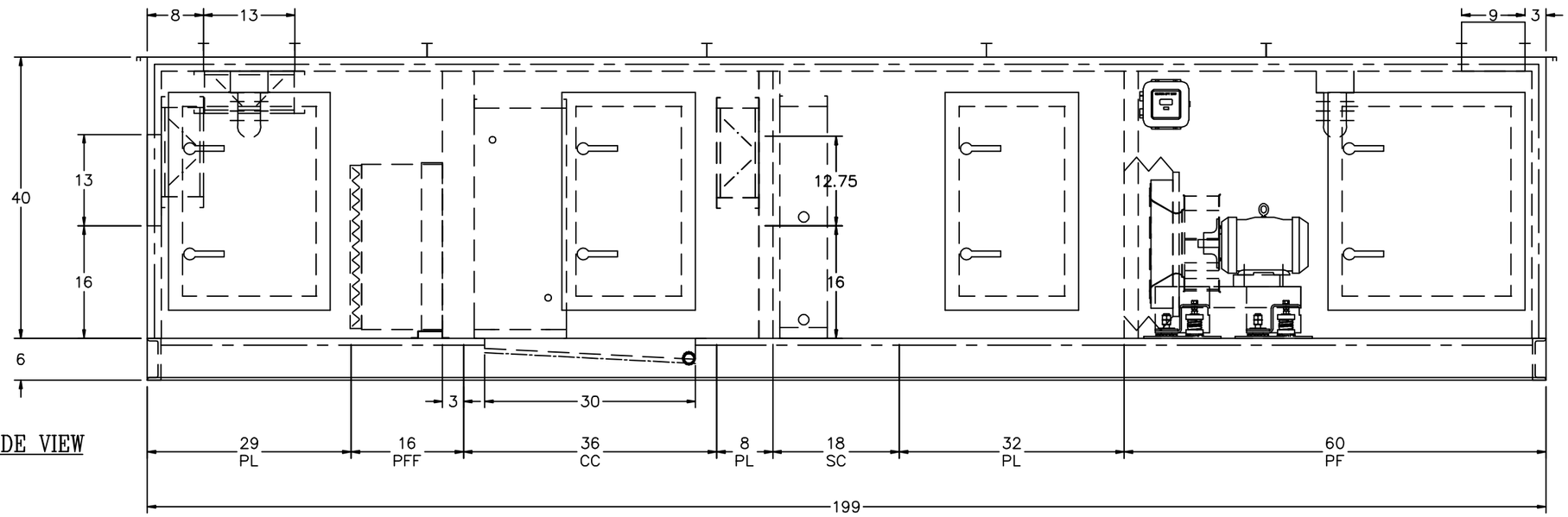
Energy Labs warrants that the products engineered and manufactured by Energy Labs is free of all defects in material and workmanship and will perform and comply with the specifications as noted in the original order and submittal. The warranty shall be in effect for a period of (12) months from the documented date of start-up or (18) months from the date of shipment, whichever occurs first. The exception to these warranty terms shall only be for extended warranty coverage negotiated at the time of the order and included in the sales terms of the order. The warranty for controls, components and accessories furnished and installed by Energy Labs shall be covered only by the terms of warranty of the control, component or accessory manufacture. This warranty covers parts only, and does not include labor for the replacement of any parts.

In the case of a defect, failure or non-compliance with the submittals, the buyer shall notify Energy Labs in writing within (30) days of discovery of the defect, failure or non-compliance. Upon proof of the defect, failure or non compliance, Energy Labs retains the right to either repair, replace, modify, exchange or refund the purchase price as necessary to correct the defect, failure or non compliance. If Energy Labs equipment has been improperly installed, started-up, operated, maintained, modified or repaired then Energy Labs accepts no responsibility for any damage or failure resulting from the fore mentioned.

Energy Labs reserves the exclusive right to authorize and issue any warranty action. No warranty action or policy may be issued by any agency representing Energy Labs, without the express written authorization of Energy Labs. Energy Labs neither accepts nor assumes any contingent liability in connection with any of its products. This represents Energy Labs sole responsibility and obligation and the buyers sole and exclusive remedy for any claim. This warranty policy is effective March 1, 2000 and supersedes and is in lieu of all other warranties expressed or implied.




PLAN VIEW




SIDE VIEW

FOAM PANEL CONSTRUCTION

PRELIMINARY MECHANICAL DRAWING
NOT FOR CONSTRUCTION

LEGEND:

| | |
|---|---|
| OSA = Outside Air | SA = Supply Air |
| RA = Return Air | EA = Exhaust Air |
| NS = Near Side | FS = Far Side |
| HS = High Side | LS = Low Side |

SECTIONS:

| | |
|---|---|
| AB = Air Blender | MB = Mixing Box |
| CC = Cooling Coil | MS = Moisture Separator |
| CU = Condensing Unit | MZ = Multizone |
| DE = Direct Evaporative | PF = Plenum Fan |
| DF = DWDI Fan | PFF = Pre/Final Filter |
| DX = DX Coil | PL = Plenum |
| EC = Economizer | PR = Pre-Filter |
| FF = Final Filter | SC = Steam Coil |
| FU = Furnace | ST = Sound Trap |
| HC = Heating Coil | VF = Vee Filter |
| IE = Indirect Evaporative | |

NOTES:
1. All dimensions are in inches unless otherwise specified.
2. Opening dimension tolerances are ± 0.50, all other cabinet dimension tolerances are ± 1.00.
3. Lifting lug locations on mechanical drawings are for representation only. Actual lifting location will vary depending on Energy Labs Engineering review.

| NO. | DATE | REVISION | DWN | APP |
|---|---|---|---|---|
| | | | | |

| | | |
|---|---|---|
| PROJECT ENGINEER: BW | | 9/6/16 |
| DESIGN ENGINEER: | | 9/6/16 |
| DESCRIPTION: | MECHANICAL DRAWING | |
| DRAWING NAME: | SU-AH-1.dwg | |
| JOB NUMBER: | 0 | |

Energy Labs Inc
1695 CACTUS ROAD
SAN DIEGO, CA 92154
(619) 671-0100

CFM: 2700/2700

MODEL: C4046-FC-L

JOB NAME: ASM Photographic Archive

UNIT TAG: AH-1

Appendix 4 – Turnkey Walk-In Cooler and Freezer Cut Sheets and Information

ADVANCED TECHNOLOGY FACILITY DESIGN & CONSTRUCTION

**Prepared for: Arizona State Museum**
**Tucson, AZ 85716**

## BUDGET QUOTATION

TO: Doug Stingelin
**GLHN Architects & Engineers**

DATE: August 19, 2016

FROM: Ben Bell/**Jeff Mitchell**
**Scientific Climate Systems, Ltd**

RE: Arizona State Museum

Dear Doug,

Please find below Scientific Climate System's budget proposal to supply the controlled environmental archive vaults for Arizona State Museum in Tucson, AZ.

Our proposal is based on the supply, delivery and installation of equipment for the Two (2) Compartment Freezer archival room and the Cool archival room. Each room is supported by independent mechanical systems.

We trust this quote will define clearly the features we are including. Upon your review, please advise if you need further details and/or clarification. We thank you for the opportunity to serve your interests.

Regards,

Ben Bell/Jeff Mitchell
Senior Sales Engineer
Scientific Climate Systems, Ltd
8208 Westpark Drive
Houston, Texas 77063
PH: 800-840-5778

## BUDGET QUOTATION 15606

**TWO COMPARTMENT ARCHIVAL STORAGE CHAMBERS FOR ARIZONA STATE MUSEUM**

**AUGUST 19, 2016**

## SPECIFICATIONS:

### FREEZER STORAGE CHAMBER

**TEMPERATURE:**
- -4° C

**TEMPERATURE TOLERANCE:**
- +/- 2º C at Sensor

**HUMIDITY:**
- 45% RH

**HUMIDITY TOLERANCE:**
- +/- 5% at humidity sensor

### COOL STORAGE CHAMBER

**TEMPERATURE:**
- 5° C

**TEMPERATURE TOLERANCE:**
- +/- 2º C at sensor

**HUMIDITY:**
- 45% RH

**HUMIDITY TOLERANCE:**
- +/- 5% at humidity sensor

## CHAMBER SIZE & CONSTRUCTION

**OVERALL SIZE:**

**FREEZER STORAGE :**
- ~15’ x 18’ x 10’4" tall

**COOLER STORAGE :**
- ~18’ x 23’ x 10’4" tall

**CHAMBER & DOOR CONSTRUCTION:**
- Modular prefab panels insulated with 4” foamed in-place urethane walls and ceiling, self supporting chamber
- All modular room panels are fire retardant
- Two-way Vent, Pressure Equalization to equalize interior chamber pressure.
- R-32 Insulation value
- Air tight room
- White smooth aluminum interior and exterior
- Baked on polyester finish

## BUDGET QUOTATION 15606

**FLOOR:**

- Freezer: With Insulated Floor
- Cooler: Less Floor

**DOOR SIZE:**

- Two (2) 36" x 84" entrance doors
- Doors to include 14" x 24" heated observation window

**MECHANICAL:**

**CONDENSING UNITS:**

- Water-cooled condensing units
- Copeland compressors
- Ozone friendly refrigerant, E.P.A. approved as environmentally acceptable
- Welded steel framework construction
- Flooded condenser and fan cycling head pressure control
- Suction accumulator
- Factory mounted liquid line solenoid valve
- Non-fused disconnect

**FAN COIL:**

- Fan coil unit installed inside each vault
- Copper tubes with aluminum fins
- Aluminum drain pan

**DE-HUMIDIFICATION SYSTEM:**

- Munter's De-humidifier HC-150 for Freezer Storage
- Munter's De-humidifier HC-300 for Cooler Storage
- Units will be in mechanical room
- Electric reactivation
- Silca Gel wheel for constant de-humidification

**FILTERS:**

- 900 CFM Carbon Filter for each Vault

**CONTROLLER FOR EACH VAULT:**

- nCompass controller/HMI
- Touch screen graphical user interface (GUI)
- 4.3" TFT color display
- Simultaneous view of two control loops
- Icon Navigation similar to smart phone devices
- View, copy and export profile, alarms, data log and audit trail files via USB, email or FTP
- Two control loops
- Auto tune standard
- Analog input supplied 18 bit resolution

- 200ms scan rate
- Relay and analog outputs for control
- Standard data logging with historical trend view
- 2 GB data storage
- Ethernet interface and RS232 serial interface
- Web server interface for monitoring only applications
- VNC severer interface to manipulate and control system remotely
- VNC server allows for access via PC, tablet or smart phone device
- Modbus communications standard
- Digital display of temperature
- High and low alarms
- Visalia temperature/humidity sensor

**UTILITIES:**

**ELECTRICAL:**

- Power furnished to control panel and mechanical room by others.
- Distribution of power from control panel at rooms and from a single power panel in the mechanical room by SCS
- Standard voltages are 208/1/60 or 208/3/60, 460/3/60
- Control voltage is 120/208V/3/60
- NEMA 1 electrical standard compliance
- All wiring color coded, identified with labels and enclosed in conduit or panel channel
- Solid state relay isolated, zero voltage switching, control relays

**LIGHTS:**

- LED Lights supplied by SCS
- Installed and wired by local electrician-not included in this quotation

**GENERAL INFORMATION FOR EACH CHAMBER**

**TESTING:**

- Chamber start-up and testing included

## BUDGET QUOTATION 15606

**TRAINING:**

- Training of all personnel at location included

**INSTALLATION:**

- By SCS's own factory trained personnel and supervised subcontractors.

**WARRANTY:**

- SCS warrants all equipment manufactured by it to be free from defects in workmanship and materials for a period of one year from date of start up of equipment.
- Ten (10) year warranty for all insulated panels, walls and ceiling

**SERVICE:**

- Provided by local SCS technical representative
- **NOTE**: SCS full service maintenance contracts available. Please contact the SCSI Service Department at 1-800-840-5778 for options and pricing.

**SHIPMENT:**

- 8-10 weeks after receipt of approved drawings

**TERMS:**

- Progressive

**BUDGETARY PRICE:**

- **$ 245,000.00 DELIVERED & INSTALLED**

**OPTIONAL PRICING USING AIR HANDLERS IN LIU OF INTERIOR FAN COIL UNITS**

- **$ 430,000.00 DELIVERED & INSTALLED**

**Excluded:**

- All plumbing, electrical, building penetrations, chases and concrete pads by others
- Roof flashing and sealing of penetrations is by others.
- Redundancy is not included within the scope of this budget quotation
- Taxes, permits and fees not included.
- Floor drains are to be provided by others
- Drainage piping for the humidifiers is by others.
- Condensation drains/traps are supplied by others.

ADVANCED TECHNOLOGY FACILITY DESIGN & CONSTRUCTION

Scientific Climate Systems, Ltd

# ARCHIVAL STORAGE

## EXPERIENCE AND CAPABILITIES

8208 Westpark Drive, Houston, Texas 77063, USA 800-840-5778, 713-781-6447, Fax: 713-781-6449

Websites: www.archivalvaults.com & www.environmentaltestchamber.com

# Advanced Technology Facilities Design & Construction

## Who is SCS?

**SCS has earned a reputation for designing and constructing Environmental Chambers and Dry Rooms that meet or exceed the demands and expectations of our customers. SCS builds superior Environmental Temperature & Humidity Chambers and Dry Rooms that don't just meet industry standards…they set them.**

- **Building Environmental Test Chambers and Dry Rooms since 1967**
- **Industry's most experienced environmental chamber and dry room engineers**
- **Commitment to manufacturing excellence**
- **Highest reliability and energy efficient chambers**

**8208 Westpark Drive-Houston, TX 77063 USA 713.781.6447**

Mr. Ben Bell
Managing Partner

**Ben joined the SCS team eleven years ago as Marketing Manager, responsible for marketing initiatives as well as sales coordination and Customer Service. In 2004 Ben assumed the position of President succeeding his father Art Bell, the company's founder. Ben has a an Economics degree from the University of Texas at Austin and over 20 year experience in marketing, sales, business development and management. At SCSI he has acquired an in depth knowledge of the high performance environmental chambers and dry rooms. Ben's commitment is first and foremost to SCS customers, and to continued growth in SCSI's by providing cost effective, reliable, and state of the art solutions to the current market sectors and leveraging SCSI's core expertise to enter new sectors.**

David Parkman
Senior Project Eng.
Mgr. Market
Development

**David joined Scientific Climate Systems as of May 2005. David has a Mechanical Engineering degree from Northeastern University and over 30 years experience in dehumidification and climate control, specializing in low humidity "Dry Room" applications. David has held key positions in sales, market development and project management with equipment manufacturers and system integrators. David's responsibilities include increasing our presence in our current markets, developing new markets, as well as working within the organization management team to support ongoing projects and customers, and develop strategic plans.**

Harold Russell
Director of Operations

**Harold joined the SCS team seven years ago as a field service engineer bringing with him over twenty years of industry experience. He has since become SCS's Director of Operations and is responsible for coordinating the installation and start up of Dry Rooms and Environmental Chambers worldwide. He works with our engineering team throughout each project and is present on the job site with our crew during the installation and start up of every Dry Room.**

Jeff Mitchell
Senior Sales Engineer

**Jeff has recently joined Scientific Climate Systems in June, 2009. Jeff has a Mechanical Engineering degree from the University of Massachusetts-Lowell and 22 years experience in the application and design of dehumidification, temperature, and air quality control systems with concentration in low dew point applications. Jeff has held positions in sales, applications, product management, and field service.**

# Setting The Standards

**Since 1967 SCS has Earned a Reputation for Designing and Constructing Dry Room Systems, Environmental Test Chambers and Archival Storage Rooms that Meet or Exceed the Demands and Expectations of our Customers.**

***SCS Doesn't Just Meet Industry Standards... SCS Sets Them!***

# The SCS Advantages

- Single Source Solutions and Guarantee of Specifications
- Universities, Museums, Libraries, Private Collections
- Installation Capabilities Throughout the World
- Designed, Engineered & Constructed by Factory Trained Engineers
- Archival Vaults with Precise Temperature & Humidity Control Providing Ideal Preservation Conditions
- Specific Filtration Engineered to Eliminate Damaging Oxidants and Outside Pollutants
- 0°F to 65°F, ± 2°F and 30% RH to 50% RH, ± 5% RH Providing Ideal Preservation Conditions

# The SCS Advantages (continued)

- Remote Mechanical Systems with Complete Redundancy
- In-House Control Systems Design
- DDC and Computer Based Control Systems for 24 Hour-A-Day Monitoring and Remote Alarms
- Archival Vaults from 100 Square Feet to 25,000 Square Feet
- Expandable Modular Panel Design with Inherent Insulation and Vapor Barrier Properties
- Aesthetic Noise and Environmental Consideration.
- Established Field Service for After Sale Support. Optional Remote Troubleshooting via Phone Modem

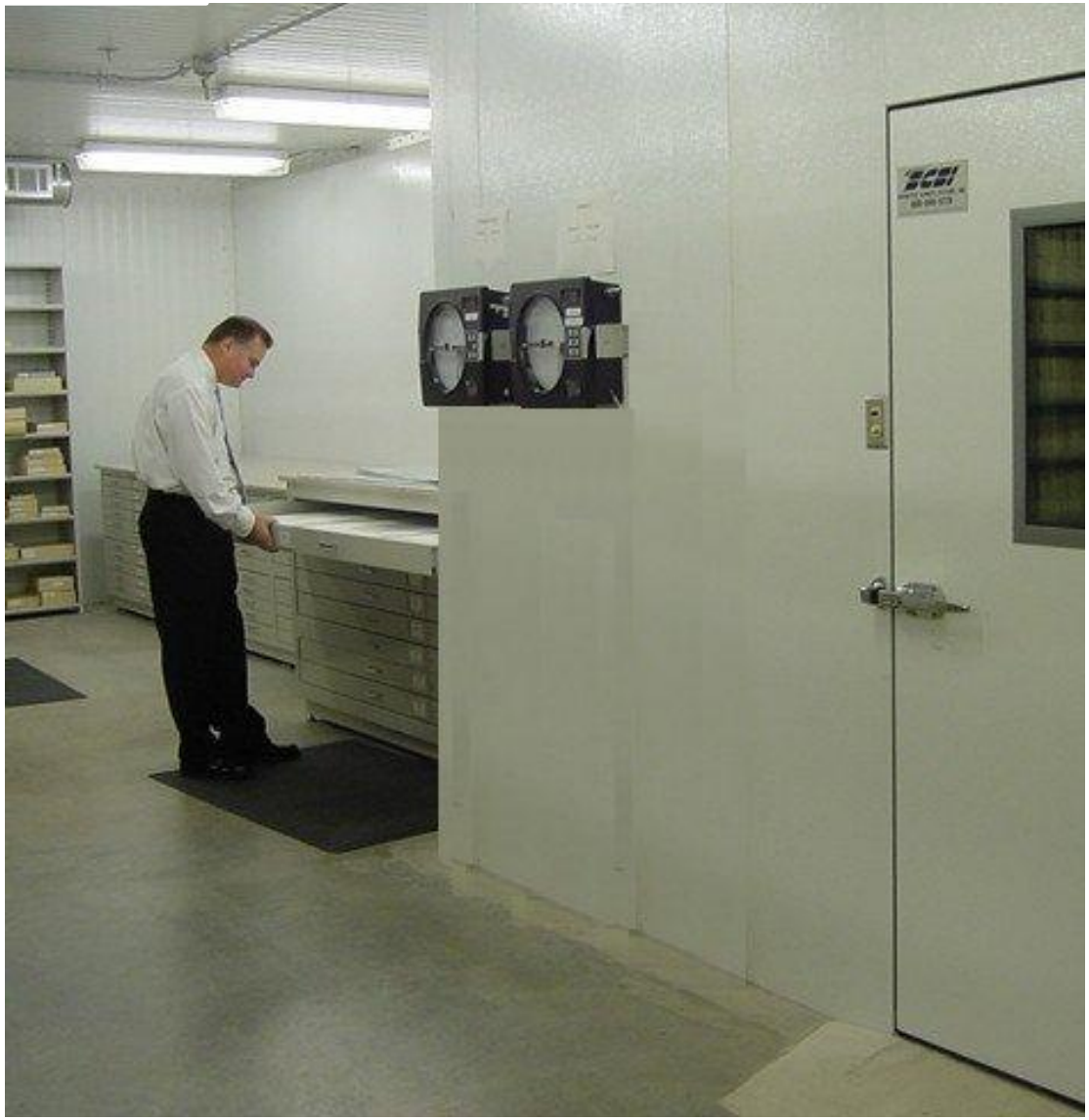
# SCS Approach to Projects

- Requirement Analysis
- Site Survey
- Comprehensive Proposal
- Cost Effective Solution Utilizing the Latest in Technology
- The Highest Quality Equipment Including Noise, Environmental and Safety Considerations
- Timely Customer Reviews
- Installation and Commissioning Supervised by SCS Factory Trained Staff
- On Site Training of Customer Personnel
- Comprehensive Technical Manuals


# Bard College-Center for Curatorial Studies

# Bard College-Center for Curatorial Studies

# Bard College-Center for Curatorial Studies



**Amon Carter Museum Archival Storage – Ft. Worth, Texas**

**Amon Carter Museum Archival Storage – Ft. Worth, Texas**

**Amon Carter Museum Archival Storage – Ft. Worth, Texas**

**Amon Carter Museum Archival Storage – Ft. Worth, Texas**

*ARCHIVE COLD STORAGE SPECIFICATIONS:*

*ROOM B108*

*TEMPERATURE:* MAINTAIN @ 60°F, +/−2°F

*HUMIDITY:* 40% RELATIVE HUMIDITY, +/−5%

*EXTERIOR FINISH:* .024 WHITE EMBOSSED ALUMINUM

*INTERIOR FINISH:* .024 WHITE EMBOSSED ALUMINUM

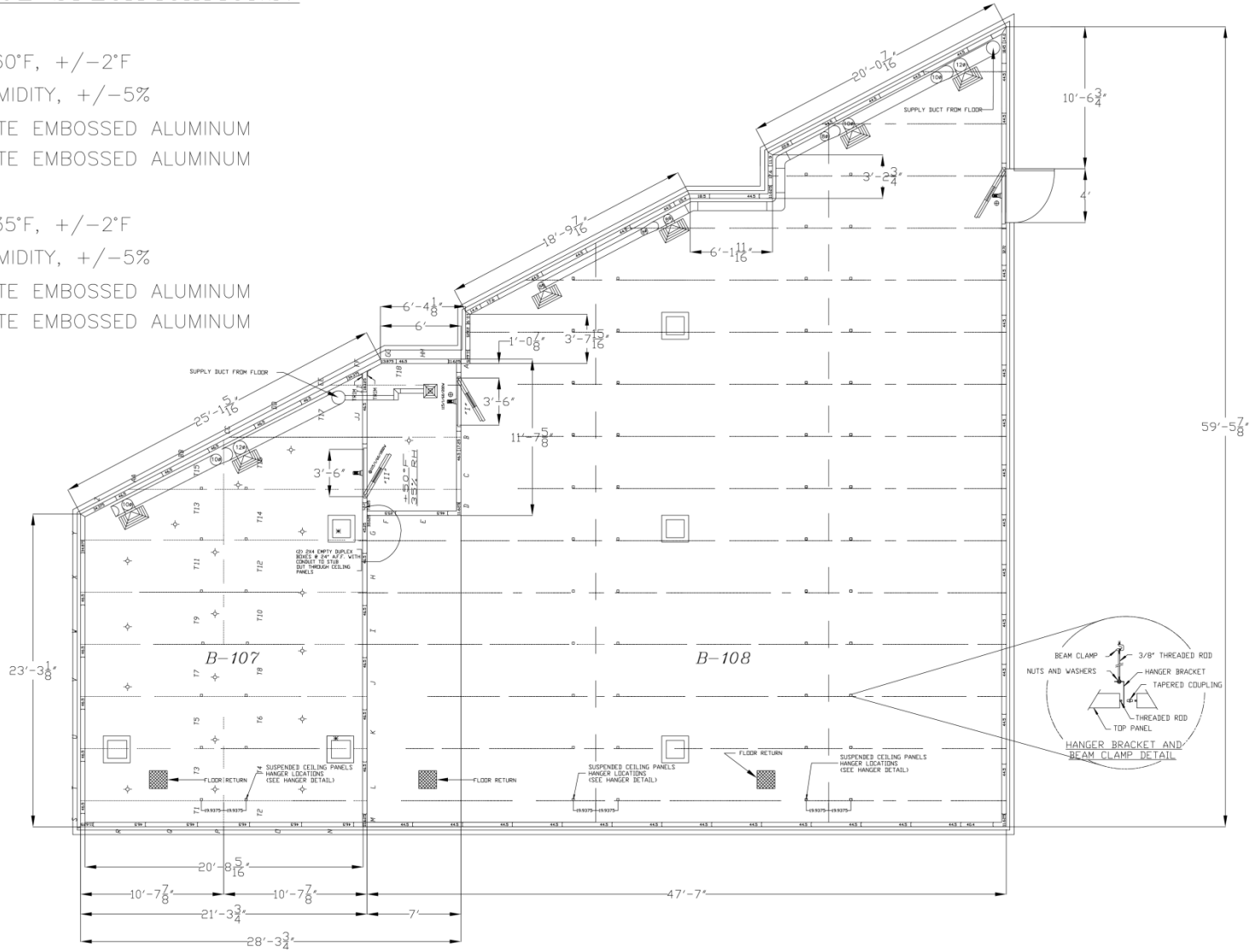
*ROOM B107*

*TEMPERATURE:* MAINTAIN @ 35°F, +/−2°F

*HUMIDITY:* 35% RELATIVE HUMIDITY, +/−5%

*EXTERIOR FINISH:* .024 WHITE EMBOSSED ALUMINUM

*INTERIOR FINISH:* .024 WHITE EMBOSSED ALUMINUM




# Amon Carter Museum Archival Storage – Ft. Worth, Texas

**Temperature & Humidity Control System – SCS Houston, TX**


Dry Room Controller with Digital Display & Paperless Recorder

# Advanced Technology Facilities Design & Construction

## SCIENTIFIC CLIMATE SYSTEMS, LTD

has been furnishing complete turnkey temperature and humidity control rooms for nearly forty years. Our experienced engineers and project managers provide complete design capability for the storage enclosure, mechanical system and the control/monitoring package. Let our staff review your requirements and develop a proposal to meet your expectations.

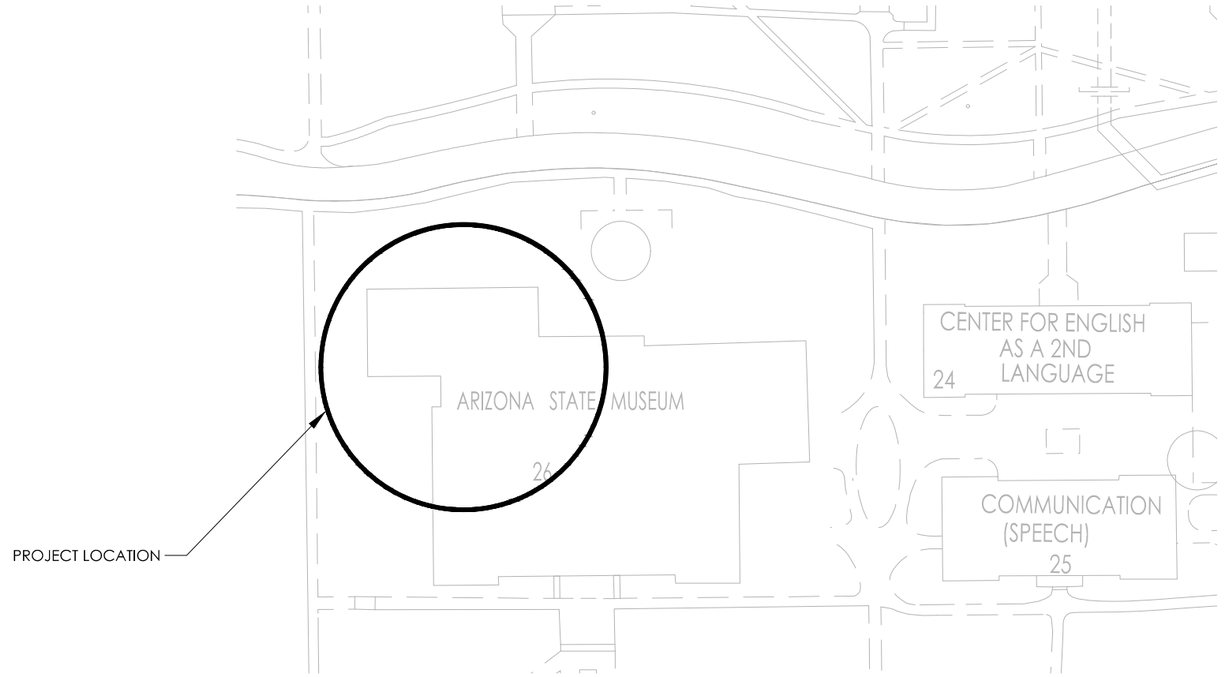

**Jeff Mitchell**
**Senior Sales Engineer**

**Phone: 713-781-6447 or 800-840-5778**

**Email:** jmitchell@scs-usa.com
**Website:** www.archivalvaults.com


Appendix 5 – Schematic Drawings

# THE UNIVERSITY OF ARIZONA
## ARIZONA STATE MUSEUM (BUILDING 26)
## RENOVATE PHOTOGRAPHIC ARCHIVES




C2 **CAMPUS MAP**
SCALE:1"=40'-0"

### SCOPE OF WORK

ARIZONA STATE MUSEUM (ASM) INTENDS TO CONSOLIDATE AND RELOCATE ITS PHOTOGRAPHIC ARCHIVE COLLECTION TO ROOM 328 OF ASM NORTH. THE PHOTOGRAPHY COLLECTION HELD BY THE ARIZONA STATE MUSEUM INCLUDES OVER 500,000 PHOTOGRAPHIC IMAGES, NEGATIVES, TRANSPARENCIES, AND GLASS SLIDES, AS WELL AS OVER 250 FILMS. A WIDE RANGE OF PHOTOGRAPHIC MATERIALS ARE CONTAINED IN THE COLLECTION, INCLUDING NITRATE, ACETATE, POLYESTER, AND GLASS.

ROOM 328 WILL BE RENOVATED TO PROVIDE A CLIMATE-CONTROLLED ENVIRONMENT - SPECIFICALLY CONSTRUCTED TO MINIMIZE THE DEGRADATION OF PHOTOGRAPHIC MATERIALS FROM HEAT AND MOISTURE USING PRECISION CLIMATE CONTROL SYSTEMS. HUMAN COMFORT WILL HAVE NO PRIORITY; ONLY THE COLLECTIONS. 1) AREA OF MOVABLE STORAGE SYSTEM WILL BE PROVIDED. 2) AREAS OF COLD CLIMATE CONTROLLED STORAGE WILL BE PROVIDED WITH THE ADDITION OF A WALK-IN FREEZER AND WALK-IN REFRIGERATOR. ONCE RENOVATION WORK IS COMPLETED, ACCESS TO ROOM 328 AND THE COLLECTION WILL BE LIMITED.

TWO OPTIONS FOR LONG TERM STORAGE ARE PROVIDED HEREIN TO ASSIST IN THE GENERATION OF COST METRICS FOR USE IN PROJECT FUNDING:

OPTION 1 - REMOVE EXISTING FURNISHINGS, BUILDING SYSTEMS, AND MEZZANINE IN ROM 328. PROVIDE 10' TALL MOVABLE STORAGE UNITS, AND 2 COLD STORAGE UNITS (FREEZER AND REFRIGERATOR) FOR LONG TERM SENSITIVE MATERIAL STORAGE. PROVIDE NEW BUILDING SYSTEMS; POWER DISTRIBUTION, LIGHTING, HVAC, FIRE PROTECTION, AND SECURITY. LOCATE MECHANICALS ABOVE COLD STORAGE ROOMS. PROVIDE PARTIAL MECHANICAL EQUIPMENT PLATFORM ONLY. TOTAL USABLE FLOOR AREA 2,158 SQUARE FEET.

OPTION 2 - REMOVE EXISTING FURNISHINGS, BUILDING SYSTEMS, AND MEZZANINE IN ROOM 328. CONSTRUCT NEW STEEL FRAMED MEZZANINE WITH CONCRETE IN METAL DECK FLOOR SYSTEM. INSTALL TWO-LEVELS OF 5'-6" TALL MOVABLE STORAGE UNITS ON MAIN LEVEL AND MEZZANINE LEVEL FOR PHOTOGRAPHIC STORAGE. THIS CONCEPT INCLUDES OPEN SPACE ON MAIN LEVEL FOR OTHER ARCHIVAL STORAGE SUCH AS HISTORICAL PAINTINGS. PROVIDE 2 COLD STORAGE UNITS (FREEZER AND REFRIGERATOR) FOR LONG TERM SENSITIVE MATERIAL STORAGE ON LOWER LEVEL. PROVIDE NEW BUILDING SYSTEMS; POWER DISTRIBUTION, LIGHTING, HVAC, FIRE PROTECTION, AND SECURITY. LOCATE MECHANICAL EQUIPMENT ABOVE COLD STORAGE ROOMS IN DEDICATED EQUIPMENT PLATFORM. TOTAL USABLE FLOOR AREA 2,455 SQUARE FEET.

### SHEET INDEX



### CODE CHECK:

UNIVERSITY OF ARIZONA / ARIZONA STATE MUSEUM
PHOTOGRAPHY ARCHIVES
BUILDING CODE: 2012 IBC
FIRE CODE: 2012 IFC
MECHANICAL CODE: 2012 IMC
PLUMBING CODE: 2012 IPC
ELECTRICAL CODE: 2011 NEC WITH AMENDMENTS
ACCESSIBILITY CODE: ANSI A117.1 2003 EDITION

CODE ANALYSIS
THIS CODE ANALYSIS IS NOT A COMPLETE CODE ANALYSIS OF THE EXISTING BUILDING. A COMPLETE CODE ANALYSIS WILL BE REQUIRED AS PROJECT MOVES FORWARD. EXISTING BUILDING IS A NONCONFORMING CONSTRUCTION TYPE. IT IS PARTIALLY EQUIPPED WITH AN AUTOMATIC FIRE SPRINKLER SYSTEM WITH CONCEALED SPACES WHICH REMAIN UNSPRINKLERED, AS WELL AS UNPROTECTED STRUCTURAL ELEMENTS. NEW AUTOMATIC FIRE SPRINKLER SYSTEM HAS BEEN ADDED TO THE BASKETRY VAULT PROJECT. AS A RESULT THE AUTOMATIC FIRE SPRINKLER SYSTEM IS AVAILABLE ON EACH FLOOR LEVEL INCLUDING THE BASEMENT LEVEL.

OCCUPANCY (CHAPTER 3)
OCCUPANCY CLASSIFICATION:
- THIS PROJECT: REMODEL EXISTING PHOTO ARCHIVES STORAGE 2,158 NSF (NO ADDITIONAL SF ADDED TO EXISTING BUILDING)
- EXISTING MIXED OCCUPANCY: A-3, B, S-1 (PHOTO ARCHIVES), S-2, F-1

GENERAL BUILDING HEIGHTS & AREAS (CHAPTER 5)
EXISTING BUILDING: 3 STORIES PLUS A PARTIAL BASEMENT
EXISTING BUILDING AREA (NO ADDITIONAL SF INCLUDED IN THIS PROJECT):
EXISTING BASEMENT: 19,132 SF
EXISTING FIRST FLOOR: 37,994 SF
EXISTING SECOND FLOOR: 28,157 SF
EXISTING THIRD FLOOR: 28,157 SF
TOTAL: 113,440 SF

OCCUPANCY SEPARATION (TABLE 508.4)
S-1 (PHOTO ARCHIVES):
ONE HOUR SEPARATION REQUIRED BETWEEN S-1 OCCUPANCY AND A-3 OR S-2 OCCUPANCIES.

- EXISTING EXTERIOR BRICK MASONRY WALLS WITH PLASTER FINISH
- EXISTING PLASTER CEILING
- EXISTING CONCRETE FLOOR
- EXISTING CLAYTILE MASONRY AND PLASTER FINISH INTERIOR WALLS

MEZZANINES AND EQUIPMENT PLATFORMS (SECTION 505)
AREA LIMITATIONS: AGGREGATE AREA OF A MEZZANINE OR MEZZANINES WITHIN A ROOM SHALL BE NOT GREATER THAN ONE-THIRD OF THE FLOOR ARE OF THAT ROOM OR SPACE IN WHICH THEY ARE LOCATED. WHERE A ROOM CONTAINS BOTH A MEZZANINE AND AN EQUIPMENT PLATFORM, THE AGGREGATE AREA OF THE TWO RAISED FLOOR LEVELS SHALL BE NOT GREATER THAN TWO-THIRDS OF THE FLOOR AREA OF THAT ROOM OR SPACE IN WHICH THEY ARE LOCATED. (505.2.1)

CLEAR HEIGHT: THE CLEAR HEIGHT ABOVE AND BELOW THE MEZZANINE FLOOR CONSTRUCTION SHALL BE NOT LESS THAN 7 FEET. (505.2)
FIRE SEPARATION DISTANCE (TABLE 602) EXISTING BUILDING PERIMETER IN 60' WIDE OPEN SPACE

| FIRE SEPARATION | TYPE OF CONST. | GROUP S1 |
|---|---|---|
| X > 30 FT | OTHERS | 0 HR |

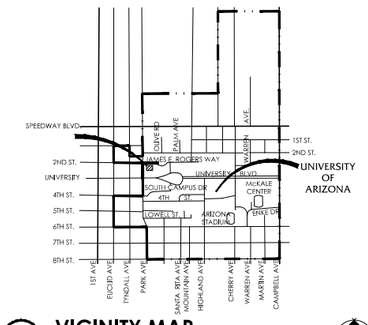
SHAFT ENCLOSURES (SECTION713)
(713.4) SHAFT ENCLOSURE REQUIREMENTS - ONE HOUR (WHERE CONNECTING LESS THAN 4 STORIES).

MEANS OF EGRESS (CHAPTER 10)
(TABLE 1004.1.2) OCCUPANT LOAD - THIS PROJECT AREA
PHOTO ARCHIVES STORAGE OCCUPANCY:
2,158 NSF / 300 GSF PER OCCUPANT = **8 TOTAL OCCUPANTS**

EGRESS WIDTH REQUIRED (SECTION 1005.3.2) (THIS AREA WITH SPRINKLER SYSTEM, BUT NOT THROUGH-OUT):
OTHER: 8 OCCUPANTS X 0.2" = 1.6": 84" PROVIDED (44" MIN. REQUIRED AT CORRIDOR, 32" CLEAR AT DOORWAY)

(TABLE 1015.1) SPACES WITH ONE EXIT ACCESS DOORWAY
REQUIRED: 1 WHERE LESS THAN 30 OCCUPANTS
PROVIDED: 2

(TABLE 1016.2) EXIT ACCESS TRAVEL DISTANCE
ALLOWABLE: 200 FEET MAXIMUM (THIS AREA SPRINKLERED, BUT NOT THROUGH-OUT)
EXISTING: 100 FEET




A8 **VICINITY MAP**
SCALE:3"=1 MILE APPROX.

THE UNIVERSITY OF ARIZONA

| NO. | REVISIONS / SUBMISSIONS | DATE |
|---|---|---|

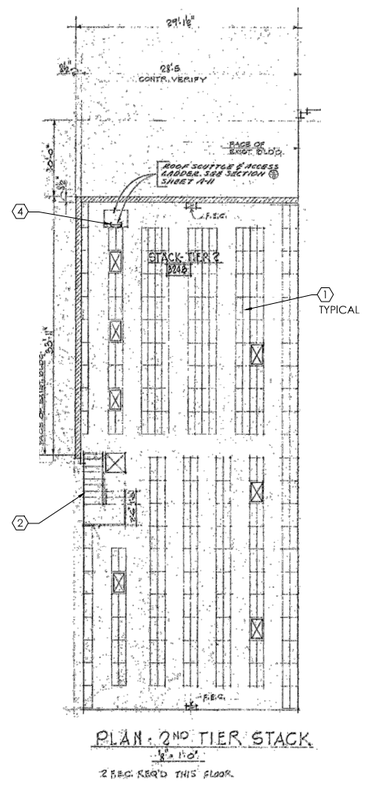
THE UNIVERSITY OF ARIZONA
ARIZONA STATE MUSEUM (BUILDING 26)
COVER SHEET


GLHN ARCHITECTS & ENGINEERS, INC
7930 E. Broadway Blvd. Tucson, AZ 85715
T 520.881.4566 F 520.795.1822 GLHN.com


NOT FOR CONSTRUCTION

| | |
|---|---|
| PROJECT NO. | 1464.10 |
| DESIGN BY: | RDS |
| DRAWN BY: | AMM/MMC |
| CHECKED BY: | RDS |
| DATE: | 2016/08/18 |

**G001**



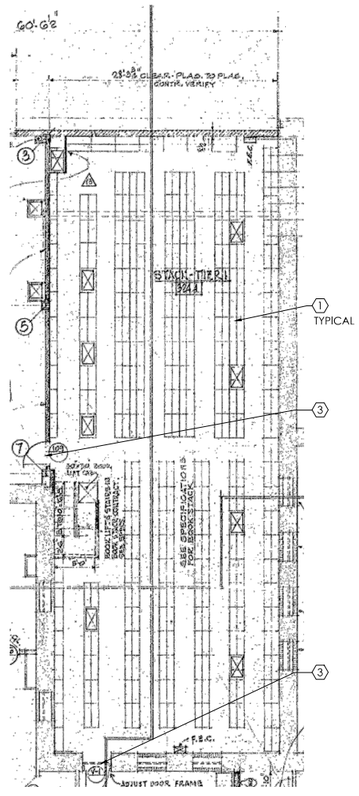

PLAN - 2ND TIER STACK

1/8" = 1'-0"

2 F.E.C. REQ'D THIS FLOOR

A1 **328 DEMO PLAN - MEZZANINE**

1/8"=1'-0"




A4 **328 DEMO PLAN**

1/8"=1'-0"

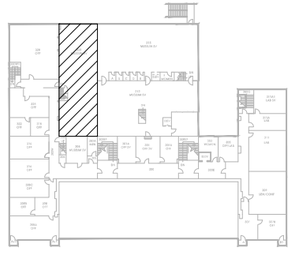
## GENERAL NOTES

1. PRIOR TO ANY DEMOLITION WORK, UA RISK SERVICES SHALL INVESTIGATE AND EVAULATE EXISTING SPACE FURNISHINGS AND SURFACES FOR HAZARDOUS MATERIALS SUCH AS LEAD PAINT AND ASBESTOS. ANY SUCH MATERIALS SHALL BE IDENTIFIED AND ABATED AS REQUIRED PRIOR TO ANY CONSTRUCTION ACTIVITIES.

2. THE OWNER MAY IDENTIFY ITEMS OF EQUIPMENT AND MATERIAL TO BE SALVAGED. RELOCATE ITEMS IDENTIFIED FOR SALVAGING TO THE LOCATION DESIGNATED. REMOVE ALL OTHER ITEMS FROM THE PREMISES.

## KEYNOTES

1. REMOVE ALL EXISTING LIBRARY SHELVING SYSTEM
2. REMOVE EXISTING STAIRWAY TO MEZZANINE INCLUDING SMALL MATERIALS ELEVATOR
3. REMOVE EXISTING DOOR
4. REMOVE EXISTING LADDER, EXISTING ROOF SCUDDLE TO REMAIN



A8 **KEYPLAN**

NTS

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|---|---|---|

THE UNIVERSITY OF ARIZONA

**THE UNIVERSITY OF ARIZONA**
ARIZONA STATE MUSEUM (BUILDING 26)

328 ARCHITECTURAL DEMO PLAN

GLHN
ARCHITECTS & ENGINEERS, INC
2939 E. Broadway Blvd. Tucson, AZ 85716
T 520.881.4544 F 520.795.1822 GLHN.com

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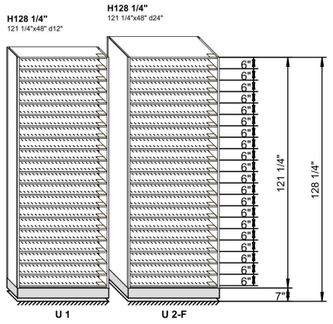
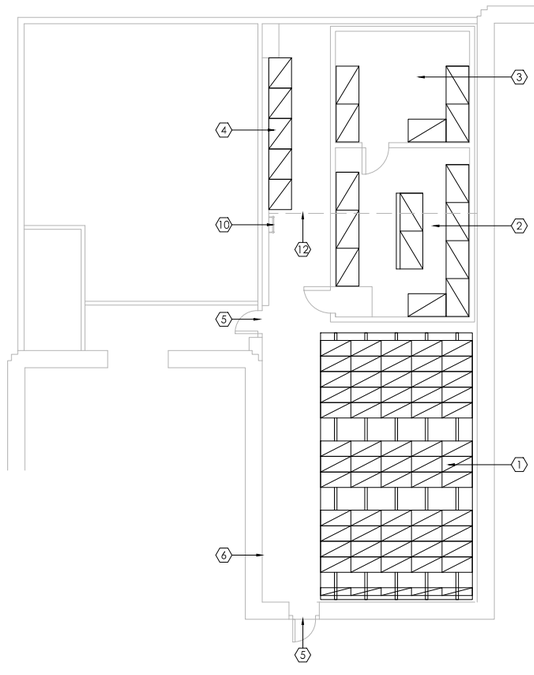
| DESIGN BY: | RDS/MMC |
| DRAWN BY: | MMC |
| CHECKED BY: | RDS |
| DATE: | 2016/08/18 |

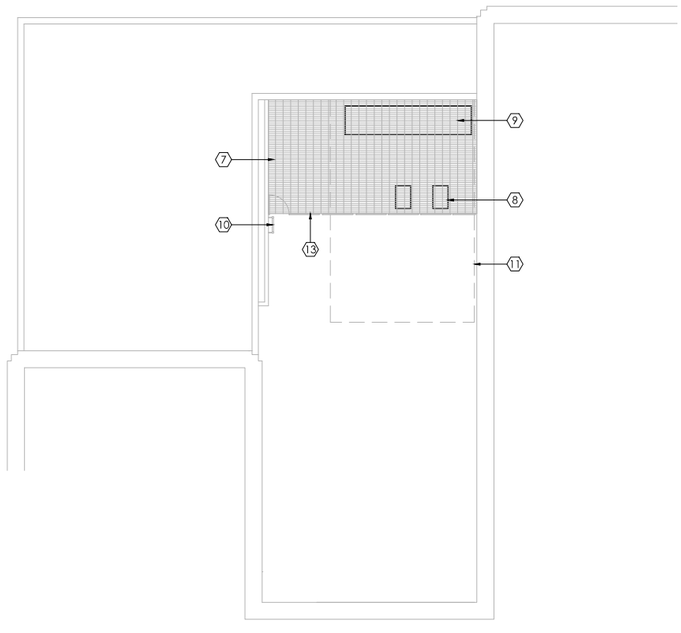
**AD101**




## F1 MOVEABLE STORAGE SHELVING DETAIL
NTS



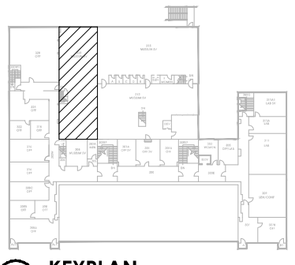

## A1 328 ARCHITECTURAL OPTION 1 PLAN
1/8"=1'-0"




## A4 328 ARCHITECTURAL OPTION 1 EQUIPMENT PLATFORM
1/8"=1'-0"

## KEYNOTES

1. MOVABLE STORAGE UNIT SYSTEM BASED ON SPACESAVER CORPORATION CAPABLE OF STORING 22,400 ARCHIVE PHOTO BOXES.
2. PACKAGED CLIMATE CONTROLLED WALK-IN REFRIGERATOR FOR ARCHIVAL STORAGE AT 5$^{o}$C. SHELVING PROGRAM TO BE DETERMINED. BASED ON SCIENTIFIC CLIMATE SYSTEMS, LTD.
3. PACKAGED CLIMATE CONTROLLED WALK-IN FREEZER FOR ARCHIVAL STORAGE AT -4$^{o}$C. SHELVING PROGRAM TO BE DETERMINED. BASED ON SCIENTIFIC CLIMATE SYSTEMS, LTD.
4. WORK TABLES
5. GASKETED AND INSULATED DOOR
6. INTERIOR SURFACE TREATMENT - LATEX BASED VAPOR RETARDER PRIMER+PAINT TO LIMIT MOISTURE MIGRATION TO/FROM ROOM 328, SHERWIN-WILLIAMS 'MOISTURE BARRIER' OR EQUAL.
7. MECHANICAL EQUIPMENT PLATFORM - GALVANIZED BAR GRATING ON WELDED STEEL TUBING SYSTEM. DESIGN LIVE LOADING TO 150#/FT$^2$. TUBING FASTENED TO EAST WALL WITH ANCHOR BOLTED WELD PLATE. STEEL POST SUPPORTS TO FLOOR FOR WEST PLATFORM BEARING
8. WATER-COOLED COMPRESSORS FOR REFRIGERATED SPACES BELOW
9. AIR HANDLER SERVING ROOM 328
10. LADDER TO ACCESS EQUIPMENT PLATFORM
11. OUTLINE OF REFRIGERATED COMPARTMENTS BELOW.
12. LINE OF EQUIPMENT PLATFORM ABOVE
13. REMOVABLE GUARDRAIL WITH ACCESS GATE



## A8 KEYPLAN
NTS

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**THE UNIVERSITY OF ARIZONA**
ARIZONA STATE MUSEUM (BUILDING 26)
328 ARCHITECTURAL OPTION 1 PLAN

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2939 E. Broadway Blvd. Tucson, AZ 85716
T 520.881.4544 F 520.795.1822 GLHN.com

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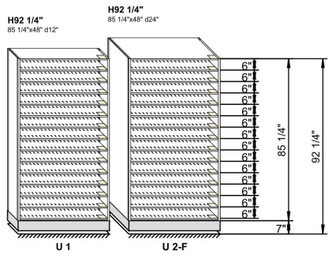
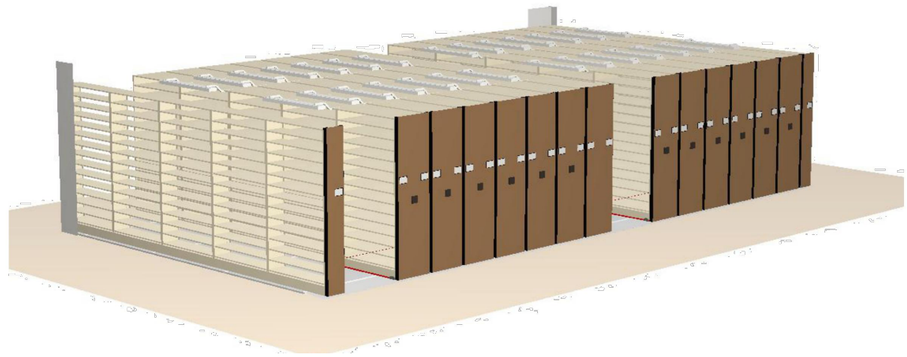
| DRAWN BY: | MMC |
| CHECKED BY: | RDS |
| DATE: | 2016/08/18 |

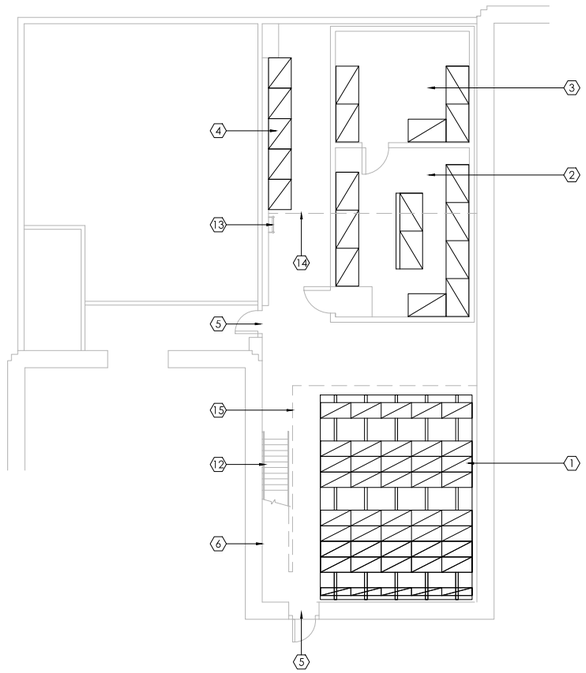
**A101**



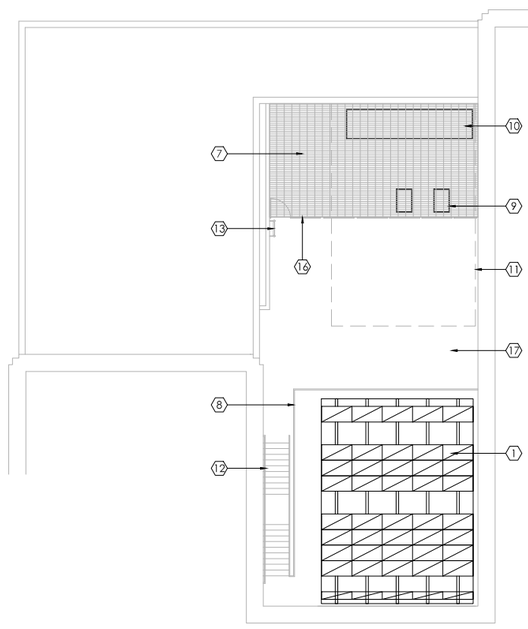

## F1 SHELVING DETAIL
NTS



## F3 MOVABLE SHELVING ISOMETRIC
NTS



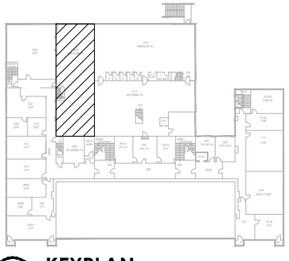

## A1 328 ARCHITECTURAL OPTION 2 PLAN
1/8"=1'-0"




## A4 328 ARCHITECTURAL OPTION 2 MEZZANINE LEVEL
1/8"=1'-0"

### KEYNOTES

1. MOVABLE STORAGE UNIT SYSTEM BASED ON SPACESAVER CORPORATION CAPABLE OF STORING 16,750 ARCHIVE PHOTO BOXES ON TWO LEVELS (8,375 ON EACH LEVEL)
2. PACKAGED CLIMATE-CONTROLLED WALK-IN REFRIGERATOR FOR ARCHIVAL STORAGE AT 5$^{0C}$. SHELVING PROGRAM TO BE DETERMINED. BASED ON SCIENTIFIC CLIMATE SYSTEMS, LTD.
3. PACKAGED CLIMATE-CONTROLLED WALK-IN FREEZER FOR ARCHIVAL STORAGE AT -4$^{0C}$. SHELVING PROGRAM TO BE DETERMINED. BASED ON SCIENTIFIC CLIMATE SYSTEMS, LTD.
4. WORK TABLES
5. GASKETED AND INSULATED DOOR
6. INTERIOR SURFACE TREATMENT - LATEX BASED VAPOR RETARDER PRIMER+PAINT TO LIMIT MOISTURE MIGRATION TO/FROM ROOM 328, SHERWIN-WILLIAMS 'MOISTURE BARRIER' OR EQUAL
7. MECHANICAL EQUIPMENT PLATFORM - GALVANIZED BAR GRATING ON WELDED STEEL TUBING SYSTEM. DESIGN LIVE LOADING TO 150#/FT$^2$. TUBING FASTENED TO EAST WALL WITH ANCHOR BOLTED WELD PLATE. STEEL POST SUPPORTS TO FLOOR FOR WEST PLATFORM BEARING
8. MEZZANINE TO BE CONSRUCTED WITH POURED CONCRETE ON METAL DECK FLOOR. DESIGN LIVE LOADING TO 150#/FT$^2$. STEEL FASTENED TO EAST WALL WITH ANCHOR BOLTED WELD PLATES. STEEL POST SUPPORTS TO MEZZANINE FLOOR FOR WEST MEZZANINE BEARING.
9. WATER-COOLED COMPRESSORS FOR REFRIGERATED SPACES BELOW
10. AIR HANDLER SERVING ROOM 328
11. OUTLINE OF REFRIGERATED COMPARTMENTS BELOW.
12. NEW STAIRCASE FOR ACCESS TO MEZZANINE
13. NEW LADDER FOR EQUIPMENT PLATFORM ACCESS
14. LINE OF EQUIPMENT PLATFORM ABOVE
15. LINE OF MEZZANINE ABOVE
16. REMOVABLE GUARDRAIL WITH ACCESS GATE
17. AVAILABLE SPACE FOR FUTURE EXPANSION, SPACE ADAPTABILITY, ETC.



## A8 KEYPLAN
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THE UNIVERSITY OF ARIZONA

**THE UNIVERSITY OF ARIZONA**
ARIZONA STATE MUSEUM (BUILDING 26)

# 328 ARCHITECTURAL OPTION 2 PLAN

GLHN ARCHITECTS & ENGINEERS, INC
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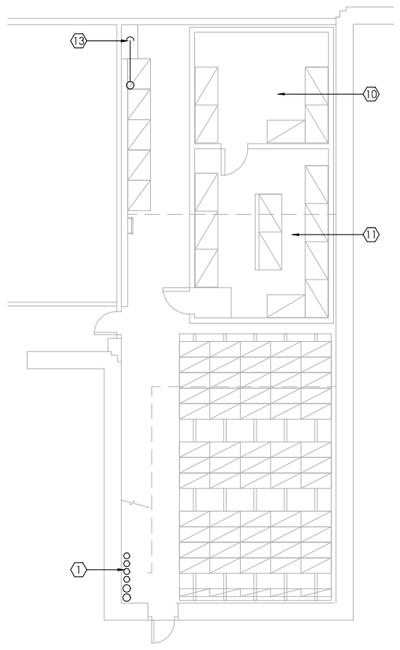
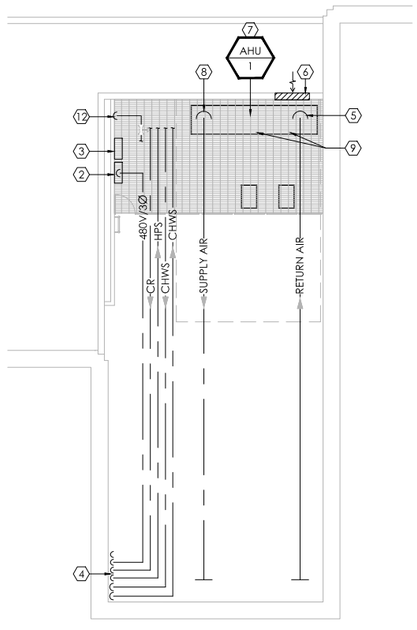
**A102**




## A1 328 BUILDING SYSTEMS OPTION 1 PLAN

1/8"=1'-0"




## A4 328 BUILDING SYSTEMS OPTION 1 MEZZANINE

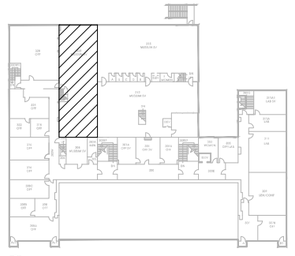
1/8"=1'-0"

## GENERAL NOTES

1. BUILDING SYSTEMS INCLUDE MECHANICAL/HVAC, ELECTRICAL POWER AND LIGHTING, FIRE ALARM, FIRE PROTECTION/SPRINKLER AND ACESS/SECURITY
2. MECHANICAL SYSTEMS - DEDICATED PRECISION CLIMATE CONTROL SYSTEMS TO BE PROVIDED FOR ROOM 328, AND INTERNAL WALK-IN REFRIGERATOR AND FREEZERS. WALK-IN UNITS TO BE FURNISHED AND INSTALLED AS A TURN-KEY SOLUTION BY THE MANUFACTURER COMPLETE WITH INSULATE D ENCLOSURE, CLIMATE CONTROL SYSTEM, POWER RECEPTACLES, AND LIGHTS. THE SURROUNDING SPACE WILL BE CLIMATE CONTROLLED BY A CUSTOM AIR HANDLING UNIT WITH OVERHEAD AIR DISTRIBUTION.
3. ELECTRICAL - POWER FOR MECHANICAL EQUIPMENT, RECEPTACLES, AND LIGHTS WILL PROVIDED BY A NEW DEDICATED FEEDER FROM BUILDING SERVICE SWITCHBOARD IN BASEMENT. LIGHTING FOR THE ARCHIVAL STORAGE SPACE TO INCLUDE LINAR COMPACT FLOURESCENT LAMPS/STRIP FIXTURES. TASK LIGHTING WILL BE PROVIDED AT WORK TABLES. LIGHTING CONTROLS WILL HAVE OCCUPANCY SENSORS WITH MANUAL ON/AUTO OFF SETTINGS.
4. FIRE ALARM - A NEW ADDRESSABLE FIRE ALARM ZONE WILL BE ADDED TO BUILDING BASE BUILDING SYSTEM
5. FIRE PROTECTION - A PREACTION FIRE SPRINKLER SYSTEM WITH LOCAL RISER SERVING ROOM 328 ONLY WILL BE PROVIDED. THE PREACTION SYSTEM WILL FEATURE A DRY-PIPE DISTRIBUTION AND WATER VALVE THAT REQUIRES AN OPEN HEAD AND SMOKE DETECTION TO RELEASE WATER.
6. ACCESS//SECURITY - A NEW CARD ACCESS SYSTEM WILL BE FURNISHED AND INSTALLED BY UA FM SECURITY CONTRACTOR UNDER A SEPARATE SCOPE OF WORK.

## KEYNOTES

1. UTILITIES UP THROUGH FLOOR FROM BASEMENT LEVEL VIA EXISTING MULTIZONE AIR HANDLING SYSTEM CHASE: 2-1/2" CHILLED WATER SUPPLY AND RETURN, 1" HIGH PRESSURE STEAM, ¾" STEAM CONDENSATE RETURN, 1" COOLING COIL CONDENSATE RETURN, 480V/ 3 PHASE ELECTRICAL POWER WITH 3 #6 CONDUCTORS AND GROUND IN 1-1/2" CONDUIT.
2. 480V/3PH 100 AMP POWER DISTRIBUTION PANEL
3. AUTOMATED CONTROLS PANEL FOR HVAC SYSTEMS
4. UTILITIES DOWN ALONG WALL
5. OVERHEAD RETURN AIR MAIN DOWN AND CONNECT WITH AIR HANDLING UNIT AHU-1
6. NEW OUTDOOR AIR INTAKE LOUVER THROUGH EXTERIOR WALL
7. AIR HANDLING UNIT AHU-1 SERVING ROOM 328 PHOTO ARCHIVAL SPACE WITH CHILLED WATER COOLING, STEAM HEATING, STEAM HUMIDFICIATION, MERV 15 FILTRATION, MIXED AIR SECTION, VARIABLE VOLUME FAN, AND DIGITAL CONTROLS. CONSTANT ENVIRONMENT TO BE MAINTAINED AT 20C/45%RH.
8. OVERHEAD SUPPLY AIR MAIN DOWN AND CONNECT WITH AIR HANDLING UNIT AHU-1
9. WATER-COOLED COMPRESSORS FOR REFRIGERATION CIRCUITS SERVING FREEZER AND REFRIGERATOR BELOW.
10. PACKAGED AND TURN-KEY WALK-IN FREEZER SYSTEM. CONSTANT ENVIRONMENT TO BE MAINTAINED AT -4C/35%RH.
11. PACKAGED AND TURN-KEY WALK-IN REFRIGERATOR SYSTEM. CONSTANT ENVIRONMENT TO BE MAINTAINED AT 5C/35%RH.
12. PREACTION TYPE FIRE SPRINKLER RISER FOR ROOM 328
13. DEDICATED FIRE SERVICE LINE UP FROM BASEMENT



## A8 KEYPLAN

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THE UNIVERSITY OF ARIZONA

**THE UNIVERSITY OF ARIZONA**
ARIZONA STATE MUSEUM (BUILDING 26)

328 BUILDING SYSTEMS OPTION 1 PLAN

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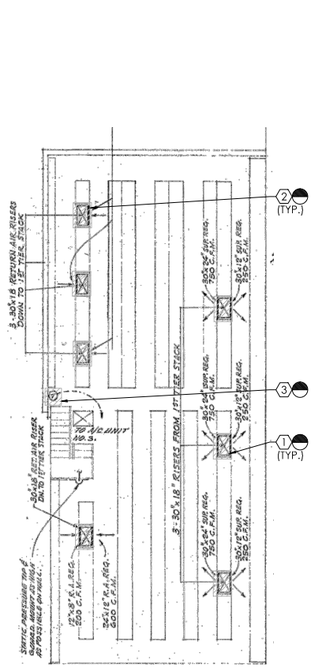
**B101**

## GENERAL NOTES

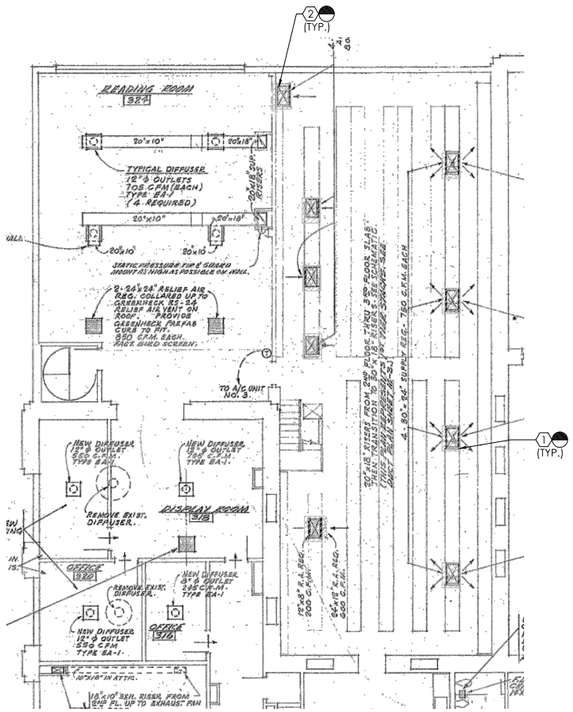
1. ELECTRICAL POWER AND LIGHTING DEMOLITION - DISCONNECT AND REMOVE ALL EXISTING STRIP LIGHTING AND POWER CIRCUITING IN ROOM 328. REMOVE CONDUIT AND PULL ALL WIRING BACK TO PANELS.
2. MECHANICAL SYSTEMS DEMOLITION - DISCONNECT AND REMOVE ALL MULTI-ZONE SUPPLY AND RETURN DUCTWORK SERVINGS ROOM 328. EXISTING MULTIZONE DUCTWORK SERVING OTHER 3RD FLOOR SPACES TO REMAIN OPERATIONAL AND BE REBALANCED UNDER NEW WORK.
3. FIRE PROTECTION SYSTEMS DEMOLITION - DICSCONNECT AND REMOVE EXISTING WET PIPE SPRINKLER SYSTEM SERVING ROOM 328. CAP BRANCH LINE FEEDING ROOM 328 AT MAIN.
4. FIRE ALARM DEMOLITION - REMOVE ALL EXISTING FIRE ALARM SYSTEM AND OR LOCAL STAND ALONE SMOKE ALARM DEVICES SERVING ROOM 328

## KEYNOTES

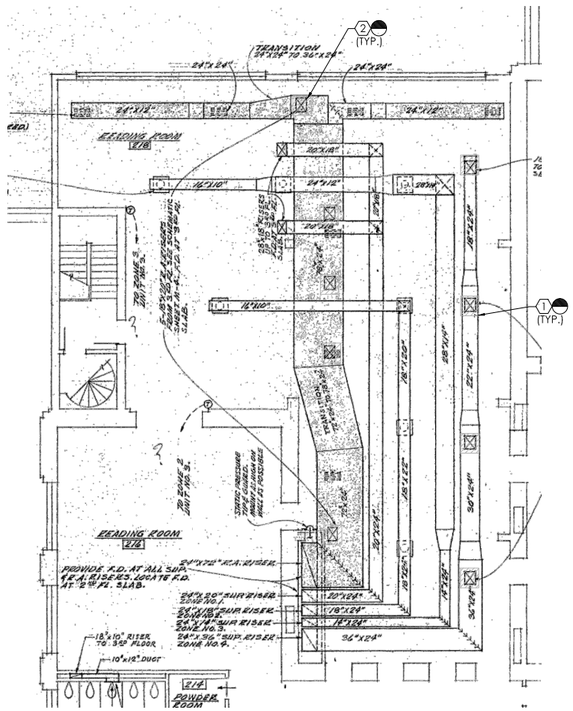
1. DISCONNECT AND REMOVE EXISTING SUPPLY AIR DUCT RISERS ABOVE SECOND FLOOR CEILING AND BELOW 3RD LEVEL FLOOR SERVING ROOM 328 (EXISTING MULTIZONE ZONE 4). CAP AND SEAL EXISTING/ACTIVE DUCT MAINS SERVING OTHER SPACES. PATCH AND SEAL EXISTING CONCRETE FLOOR OPENING. ABANDON SUPPLY AIR DUCT ABOVE 2 FLOOR CEILING. DISCONNECT AND DEACTIVATE MULTI ZONE 4 IN BASEMENT. REBALANCE REMAINING ACTIVE ZONES PER NEW WORK.
2. DISCONNECT AND REMOVE EXISTING RETURN AIR DUCT RISERS ABOVE SECOND FLOOR CEILING AND BELOW 3RD LEVEL FLOOR. CAP AND SEAL EXISTING/ACTIVE DUCT MAINS SERVING OTHER SPACES. PATCH AND SEAL EXISTING CONCRETE FLOOR OPENING.
3. DISCONNECT AND REMOVE EXISTING PNEUMATIC THERMOSTAT TUBING BACK TO MANIFOLD.



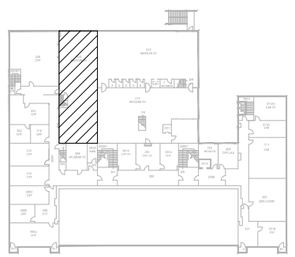

A1 **328 DEMO PLAN - MEZZANINE**
1/8"=1'-0"




A3 **328 DEMO PLAN**
1/8"=1'-0"




A6 **2ND FLOOR DEMO PLAN**
1/8"=1'-0"



A8 **KEYPLAN**
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**THE UNIVERSITY OF ARIZONA**
ARIZONA STATE MUSEUM (BUILDING 26)
328 BUILDING SYSTEMS DEMO PLAN


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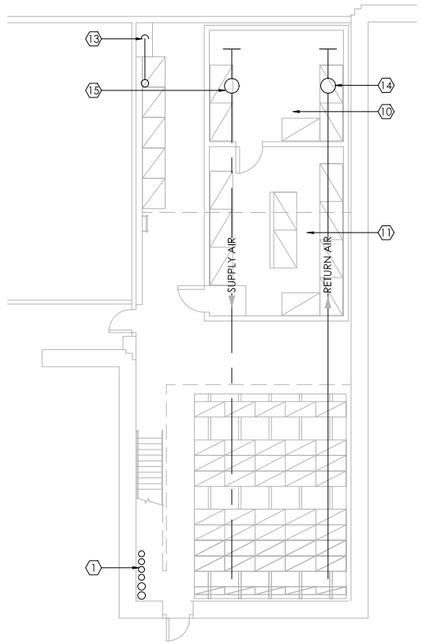
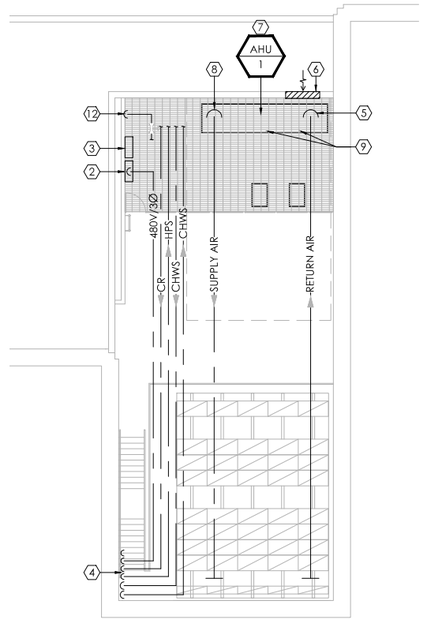
**BD101**




A1 **328 BUILDING SYSTEMS OPTION 2 PLAN**
1/8"=1'-0"




A2 **328 BUILDING SYSTEMS OPTION 2 MEZZANINE**
1/8"=1'-0"

## GENERAL NOTES

1. BUILDING SYSTEMS INCLUDE MECHANICAL/HVAC, ELECTRICAL POWER AND LIGHTING, FIRE ALARM, FIRE PROTECTION/SPRINKLER AND ACESS/SECURITY
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## KEYNOTES

1. UTILITIES UP THROUGH FLOOR FROM BASEMENT LEVEL VIA EXISTING MULTIZONE AIR HANDLING SYSTEM CHASE: 2-1/2" CHILLED WATER SUPPLY AND RETURN, 1" HIGH PRESSURE STEAM, ¾" STEAM CONDENSATE RETURN, 1" COOLING COIL CONDENSATE RETURN, 480V/ 3 PHASE ELECTRICAL POWER WITH 3 #6 CONDUCTORS AND GROUND IN 1-1/2" CONDUIT.
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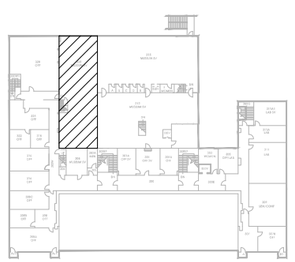
11. PACKAGED AND TURN-KEY WALK-IN REFRIGERATOR SYSTEM. CONSTANT ENVIRONMENT TO BE MAINTAINED AT 5C/35%RH.
12. PREACTION TYPE FIRE SPRINKLER RISER FOR ROOM 328
13. DEDICATED FIRE SERVICE LINE UP FROM BASEMENT
14. OVERHEAD RETURN AIR DUCT MAIN UP AND MAKE BOTTOM CONNECTION WITH AIR HANDLING UNIT ON EQUIPMENT PLATFORM
15. OVERHEAD SUPPLY AIR DUCT MAIN UP AND MAKE BOTTOM CONNECTION WITH AIR HANDLING UNIT ON EQUIPMENT PLATFORM



A8 **KEYPLAN**
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THE UNIVERSITY OF ARIZONA

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ARIZONA STATE MUSEUM (BUILDING 26)

328 BUILDING SYSTEMS OPTION 2 PLAN

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**B102**

# Mechanical System Design Consultation

**Arizona State Museum,**
**Photograph Collection Storage**

**November 2014 – November 2016**

Jeremy Linden, Senior Preservation Environment Specialist
Christopher Cameron, Sustainable Preservation Specialist
Image Permanence Institute

Image Permanence Institute ▪ Rochester Institute of Technology
70 Lomb Memorial Drive ▪ Rochester, New York 14623
Phone (585) 475-5199 ▪ www.imagepermanenceinstitute.org

## PROJECT OVERVIEW

As part of a National Endowment for the Humanities Sustaining Cultural Heritage Collections Planning Grant, the Arizona State Museum contracted with the Image Permanence Institute (IPI) to provide expertise on the design and location of a mechanical system that would serve their photographic collection.

The goal of the project is to enable The Arizona State Museum staff to make informed, strategic decisions regarding long-term collection stewardship, space allocation, mechanical system operation, and sustainable preservation practices. The IPI consultants for this project were Jeremy Linden, Senior Preservation Environment Specialist and Christopher Cameron, Sustainable Preservation Specialist.

As part of the grant, the museum purchased 10 PEM2® dataloggers for installation in the museum's photograph collection storage spaces. Data gathered during the project was uploaded to IPI's eClimateNotebook™ web analysis platform, where it was available to all participants. Training in eClimateNotebook was included for all interested staff members. This project included one onsite visit to work with the museum staff, which took place November 13-14, 2014.

This is the final report and presentation of findings to the museum. Included are recommendations for better conditioning of the current spaces and an evaluation of the proposed freezer/refrigerator space.

Jeremy Linden
Chris Cameron
Image Permanence Institute
Rochester Institute of Technology
April 2016

**Project Duration** **11/2014 – 11/2016**

**Photograph Collection Storage**

The photography collection held by the Arizona State Museum includes over 500,000 photographic images, negatives, transparencies, and glass slides, as well as over 250 films. It documents many highly significant archeology and ethnology studies conducted by University of Arizona faculty and student researchers in the American Southwest over the past one-hundred years. The collection continues to grow as prominent professors retire and transfer collected documentation to the museum. While the number of prints and traditional photographic images being added to the collection is declining, the number of digital images being added is growing quickly. Currently, the collection consists of:

| | |
|---|---|
| Turn of the century negatives | c. 400,000 |
| Photographic images | c. 20,000 |
| Color transparencies | c. 100,000 |
| Glass plate negatives | c. 2,000 |
| Lantern slides | c. 2,000 |
| Films | c. 250 |
| **Total Photograph Collection** | **c. 525,000** |

A wide range of photographic materials are contained in the collection, including nitrate, acetate, polyester, and glass. Some of the films in the collection are showing signs of vinegar syndrome, which occurs when acid is generated within the cellulose acetate support layer, and then diffuses into the gelatin emulsion and often into the air, creating a sharp, acidic odor. The degradation of cellulose acetate film base can also cause distortion, shrinkage, and brittleness. These chemical reactions are influenced by the storage environment (heat and moisture) and/or the presence of acidic vapors from film degrading nearby.

Recently some of the nitrate-base films in the collection were lost when University of Arizona Risk Management Services required their disposal. Nitrate film can emit acidic gases as it deteriorates, which can be absorbed by other film stored nearby. It is also highly flammable. The museum was able to copy the films before they were destroyed. The remaining nitrates are currently being stored in two different locations in Building 26. Some are stored in room 202, which is served by AHU 10 and AHU 11 air-handlers, both two-pipe systems that date prior to 1963. On days of high humidity, particularly during the summer monsoon season, dehumidifiers are employed to keep the RH from climbing too high. The bulk of the remaining nitrates are "temporarily" being stored in room 123A, a small research room located within one of ASM's two climate controlled storage rooms, but which is served by a different air-handler without humidity control (i.e. AHU 2 air-handler that serves the Conservation lab). Because the research room (123A) is located within the secure storage room (123), the door between the research room and the main

collections storage room is left open to enable mixing with the temperature and humidity conditioned air of the larger storage room (123).

Steven Weintraub, conservator and environmental preservation specialist, was hired to examine the museum's collection space in 1990. He noted the lack of moisture control within the mechanical system, excessive space temperatures, and poor air distribution as serious issues in his report at that time. Weintraub provided recommendations to the museum that included making all units four pipe units instead of two (i.e., including supply and return for both chilled and hot water) to allow easier switching from heating to cooling. He also recommended the replacement of the pneumatic system with electric controls to allow for better control of the system, and investigating the humidity control through upgrades or new equipment. Cleaning of all ductwork and the replacement or upgrade of filters was also suggested.

Few of the recommendations given in 1990 have been attended to and the systems, for the most part, are still in need of upgrading. The Museum is dependent on the University of Arizona's Facilities Management for regular maintenance and upgrades to the system. Unfortunately, due to the large number of buildings on campus, over one hundred, many of which have human occupancy concerns, the University has not been able to address these issues. The Museum has however made efforts to improve the collection environment. Two recent significant upgrades for storage of ASM's two Save America's Treasures designated collections of pottery and basketry have been made possible through grant funded initiatives launched by the Museum.

The ASM photograph collection is housed in seven separate locations within two University of Arizona buildings (Buildings 26 & 30) that the museum occupies. The entire collection was originally housed in the basement of Building 30, which was purpose built as a museum in 1935 but without considerations for creating a stable preservation environment. Most of the collection was moved to Building 26 in winter 2010-2011 to facilitate greater adjacency between it, the catalogued object collection, and the relocated photography studio (room 206). A small portion of the collection is still being housed in the basement of Building 30 in room 103B. The collections in Building 26 are currently being stored in rooms 202, 203, 123A (Pottery Vault Research Room), and 125 (Conservation Lab). There are also some collections that are located in room 204 (Photo Curator's Office) and in room 206 (Photography Studio) as they are being processed. The museum has attempted to house similar collection types together (negatives, transparencies), however these collection types consist of different materials (acetate, nitrate, polyester) that require different preservation conditions.

The mechanical systems that condition the storage environments are not optimal for the collection. Rooms 202, 203, 204, and 206 in Building 26 are conditioned by two single-zone two-pipe fan coil units/air handling systems (AHU 10 & 11) that are over fifty years old, some of the oldest at the facility. Building 26 was originally built

as the library for the University of Arizona, and the air handling systems were designed for human comfort. These units have no capacity for humidification or dehumidification, which is evident in the high and low moisture events seen in the data.

The air-handling systems that serve rooms 123A and 125 in building 26 are newer and were installed during building renovations in 2006. AHU 1 is the dedicated system for the climate controlled pottery storage vault (room 123) and is capable of dehumidification. AHU 2 serves the ASM conservation lab (room 125). It also serves the small research room (123A) that is accessed through the pottery vault (123). AHU 2 does not have dehumidification capabilities; therefore, the environment in room 123A is more similar to the environment in the conservation lab than in the pottery vault, unless the door between the research room (123A) and the pottery vault (123) is left open. The door does not pose a security risk and is left open to provide better conditioning for 123A and any materials that may be stored inside.

The basement of Building 30 is heated and cooled by a central fan coil unit with no capability for humidification or dehumidification. In the event of the dew point in the space rising during the rainy season, dehumidifiers were added to the collection space. The air is supplied through diffusers distributed throughout the space but is returned through passive means by passing through the space because there is no return air duct system.

**Storage Space Requirements**

The museum's plan is to reevaluate the collection spaces at the museum and determine if any of the current locations, or other onsite locations, may be suitable for housing the entire photographic collection. The criteria for new photographic collection storage space include:

- Proximity to the museum
    - Offsite storage space may be available, but would be better suited for storing other materials in order to open up space for the photograph collection.
- A long-term solution to the storage and environment needs
- The ability to add a freezer and refrigerator for the remaining nitrate and acetate collection
- Enough additional space to hold materials transferred by retiring professors over the next 15-20 years
- Environmental conditions suitable for long-term collection preservation rather than for human comfort

Current Spaces:

- Nearly all spaces used currently have room temperatures that exceed the ISO recommendation for preservation.

    - Extended periods of time at high temperatures accelerate the rate of chemical decay of organic materials.
- For most spaces, the relative humidity is between 15-40% for most of the year. However, from July to mid-October the RH in these spaces can climb to over 60% and even as high as 70%.
- The TWPI or rate of "natural aging" for many of the spaces is reduced (indicating an increased rate of decay) due to the 3-4 months of high humidity that the spaces experience.
    - TWPI of 45 or less = Risk, 45 to 75 = OK, and over 75 = Good conditions. See the Appendix on page 12for more information.

**Building 30**
**Storage space:** **B-103B**
**Location:** Basement

**Description:**
The space was formerly the photography studio and dark room for the museum. A small amount of material is still stored in this space, although the majority has been moved to Building 26. There have been issues with moisture and pests in this space in the past.

**Conditions:**
Although moisture levels inside this space stay in a safe range, for film, for most of the year (between 15% and 40%), the temperatures are too warm for safe storage of photograph collections in the long term. The temperature in the space is nearly a flat 75°F and is currently one of the warmest spaces the collection is housed in.

**Time Weighted Preservation Index (TWPI): 48**

| Collection | Environment | Materials | Temperature Suitability | Humidity Suitability |
|---|---|---|---|---|
| 103B Dark Room | Room Temperature | Nitrate Black & White, Nitrate Color, Polyester Black & White, Polyester Color, Acetate Color, Acetate Black & White | Unacceptable | Acceptable |

The characterization overviews included in this report come from a film collection environment analysis performed on FilmCare.org. The overview above pertains to the quality of the environment for the film collection and may not directly pertain to the photographic images in the collection.

**Building 26**
**Storage space:** **Rooms 202, 203, 204**
**Location:** 2nd Floor at the top of the stairs

**Description:**
When the building was used as a library this space contained the circulation desk. Originally one open space, the area was later turned into individual offices or storage spaces, and the air handing system was not adjusted for the change. Rooms 204 (AHU 11) and 203 (AHU 10) are served by a single air handling unit and room

202, the central and largest of the three rooms, is served by a mix from two AHUs (AHU 10 and AHU 11). These rooms receive the same air as the library spaces. These spaces were considered a possible location for housing the photography collection, but there were too many concerns:

- Can the building structure handle the total weight of the proposed changes (freezer, collection, equipment, shelving)?
- What is the impact on the building?
    - Are there structural changes that may need to be addressed?
    - Are there historical aspects of the facility that cannot be modified?
- What will the renovation cost?
- Between design and setup time requirements, the transition to storage may not start for a year
- Can this space be used for something else?

It was determined that these spaces were not appropriate for storage of the entire collection and the unanimous decision was to abandon the idea of using Rooms 202, 203, and 204 for this purpose.

**Conditions:**
The current environmental conditions for these rooms have seasonal temperature ranges of 60-80°F with 15% RH in the winter and summer conditions of 68°F with 80% RH. Though it is believed that Room202 is served by two air handing units, all three rooms have the same dew point signature. Though the RH fluctuates widely in the space, the majority of the time it is within the safe range for a film collection. The temperature in the space is of greater concern. There are periods where the temperature rises to almost 80°F, much warmer than what is recommended for photo storage.

**Time Weighted Preservation Index (TWPI): 46**

| Collection | Environment | Materials | Temperature Suitability | Humidity Suitability |
|---|---|---|---|---|
| 202 Photo Collection Middle | Room Temperature | Polyester Black & White, Polyester Color, Acetate Color, Acetate Black & White | Unacceptable | Acceptable |
| 203 Photo Collection East | Room Temperature | Nitrate Black & White, Nitrate Color, Polyester Black & White, Polyester Color, Acetate Color, Acetate Black & White | Unacceptable | Acceptable |
| 204 Photo Collection West | Room Temperature | Nitrate Black & White, Nitrate Color, Polyester Black & White, Polyester Color, Acetate Color, Acetate Black & White | Unacceptable | Acceptable |

The overview above pertains to the quality of the environment for the film collection and may not directly pertain to the photographic images in the collection.

**Building 26**
**Storage Space:** **Room 206 (Photography Studio)**
**Location:** West side of the 2nd floor

**Description:**
Room 206 is currently used as the photography studio for the museum, it also serves as additional storage for collections, using cabinets along the north wall. Only a small amount of photographic material is stored here as it is being processed. Room 206 is currently being used as a staging area for incoming newly accessioned photographic materials. This space also serves as short term housing for collections that are brought into the space to be photographed. The equipment used in the Photography Studio (lights, cameras, overhead lights) can add to the temperature in this high-ceiling space.

**Conditions:**

The environment in this space is similar to many of the other spaces in Building 26. The temperature averages around 73°F throughout the year. It is possible that the lighting and equipment used in the space add to the heat load, making the room warmer than expected. The humidity in the space follows the same pattern as many other spaces, although without the drastic highs. There are year-round low RH levels between 15-40% and peaks at around 70% in the summer. The low RH in the space is due to the use of higher temperatures.

**Time Weighted Preservation Index (TWPI): 43**

| Collection | Environment | Materials | Temperature Suitability | Humidity Suitability |
|---|---|---|---|---|
| 206 Photography Studio | Room Temperature | Nitrate Black & White, Nitrate Color, Polyester Black & White, Polyester Color, Acetate Color, Acetate Black & White | Unacceptable | Acceptable |

The overview above pertains to the quality of the environment for the film collection and may not directly pertain to the photographic images in the collection.

**Building 26**
**Storage Space: Room 123A**
**Location:** East side of the 1st floor, north wall within the Pottery Vault

**Description:**
This small space is used to house items in the photography collection, primarily slides, though there are some nitrate materials as well. Materials in 123A are housed in a variety of ways, including boxes on shelves, storage inside metal cabinets, and in film canisters on shelves.

**Conditions:**
Though this space is inside the Pottery Vault, it is served by the same AHU that serves the Conservation Lab (AHU 2). Conditions in this space are similar to the Conservation Lab and very different from the Pottery Vault (served by AHU 1). This

is the coolest space used to house photography collections. The average temperature in this space is around 66°F. The cool temperature helps to keep the RH between 30-40% most of the year. However, this same temperature causes the RH to climb to almost 70% in late August/early September.

**Time Weighted Preservation Index (TWPI): 55**

| Collection | Environment | Materials | Temperature Suitability | Humidity Suitability |
|---|---|---|---|---|
| 123A Pottery Vault Research | Room Temperature | Nitrate Black & White, Nitrate Color | Unacceptable | Acceptable |

The overview above pertains to the quality of the environment for the film collection and may not directly pertain to the photographic images in the collection.

## Recommendations

The recommendations below are designed to improve the preservation quality of the collection environment at the Arizona State Museum:

### Replace Current AHUs

- Many of the current AHUs are not capable of producing a quality preservation environment.
    - Dehumidification and humidification capabilities are limited. This limits the potential to manage the system better, especially in the summer months, to improve the collection environment.
- The chemical decay of many of the collection materials can reduced through the use of cooler conditions. The winter high temperatures around 80°F can be very damaging to collection materials.
- Newer mechanical systems can be designed to take advantage of energy savings practices (nightly setbacks, system shutdowns, fan speed reductions) that can allow the operation of the system to be reduced or halted for a period of time to reduce energy consumption, with little impact to the collections environment.
- New units would be recommended that could not only provide better moisture control for the collection but could also produce cooler temperatures.

### Add dehumidification capability

- Adding additional dehumidification to the AHU will help alleviate the high RH in the summer months. This would allow cooler temperatures to be used, improving the overall storage condition.
    - This works best if photograph collection materials are physically consolidated--otherwise multiple AHUs will need the addition of humidification.

### Use seasonal set points

- Many of the spaces spend up to nine months at room temperature with low RH levels. During the summer the RH increases to unsafe levels. The normal reaction would be to increase the temperature to reduce the RH. Unfortunately, photographic material responds negatively to increases in temperature. Consider:
    - Lowering the room temperatures a few degrees to help improve the RH over the long period of low RH, while providing cooler conditions for the collection.
    - Raising the temperature back to current levels during the summer months to help keep the RH in line with what the materials are used to, while not driving the temperature up and speeding up the decay of the materials.

**Reduce the heat load in the space**

- In rooms like the Photography Studio, it is possible to reduce the heat load by:
    - Turning off lights when no one is in the room
    - Turning off equipment when not in use

**Consolidate collections in appropriate storage spaces**

- Store similar materials together, and remove vulnerable materials from rooms with little or no environmental control. Work to eliminate the use of spaces with poor environmental conditions for collection storage.
    - In some spaces the current conditions may be the best that can be achieved.
    - In other spaces there are few if any options for control since a change to the discharge air temperature may affect occupied spaces served by the same system.
    - There are also spaces that do not have the ability to be adjusted.

**Refrigerate or cool as much as possible**

- Adding small refrigerators or freezers will help in the short term to preserve materials that are highly valuable and/or particularly vulnerable.

**Room 328 - Walk-in Refrigerator/Freezer Design:**

Room 328 was recommended as a possible "storage solution" for the aggregate of the photography collection, with the addition of a walk-in freezer and a walk-in refrigerator. The space, which once served as the state archives, is an excellent candidate, particularly because the floor should be able to hold the weight of the walk-in units. There is only one outside wall, so the load can be significantly reduced. The entire room should not be needed, leaving the option to use some of the room as a flex space. The facilities' architects should evaluate the structure to determine the feasibility of this idea.

**Current proposed design for Room 328**

***Freezer:***

-20°C (-4°F) 45%RH -29°C (-20°F) DP

- PI 9999[1]
- Temperature and RH provide excellent conditions for long term storage of nitrate, acetate (negative, film, slides, transparencies, etc.), polyester, photographic prints, and ink jet print materials.
- Glass plates, magnetic, or optical media should not be frozen.
- If possible, try to locate the dehumidifier outside of the freezer to eliminate any excess heat.

***Refrigerator:***

5°C (41°F) 45%RH -6°C (20°F) DP

- PI 360
- Temperature and RH provide excellent conditions for long term storage of glass plates, magnetic media, digital media.
- Dew Point of the refrigerator does not allow for the ease of transition of materials from the freezer to the refrigerator without condensation.
    - A container such as a cooler or a plastic bag should be used and materials should be allowed to equilibrate before being removed from the container.
- If possible, try to locate the dehumidifier outside of the freezer to eliminate any excess heat.

***Room 328:***

- The current plan involves the replacement of the HVAC system that serves 328. The temperature conditions that this space will be set to are not currently known. Below are some recommended conditions for room 328, assuming the bulk of the collection stored here will be b&w prints.
    - Option 1
        - September-June 60° 30% RH 143 PI
        - June-September 60° 55% RH 72 PI
            - With little to no occupancy the space can utilize lower temperatures to improve the preservation of the collection.
            - The seasonal RH levels allow for safe drifts in RH that take advantage of the seasonal change. This helps conserve energy by not attempting to produce a year round flat line RH level that will overwork the unit.

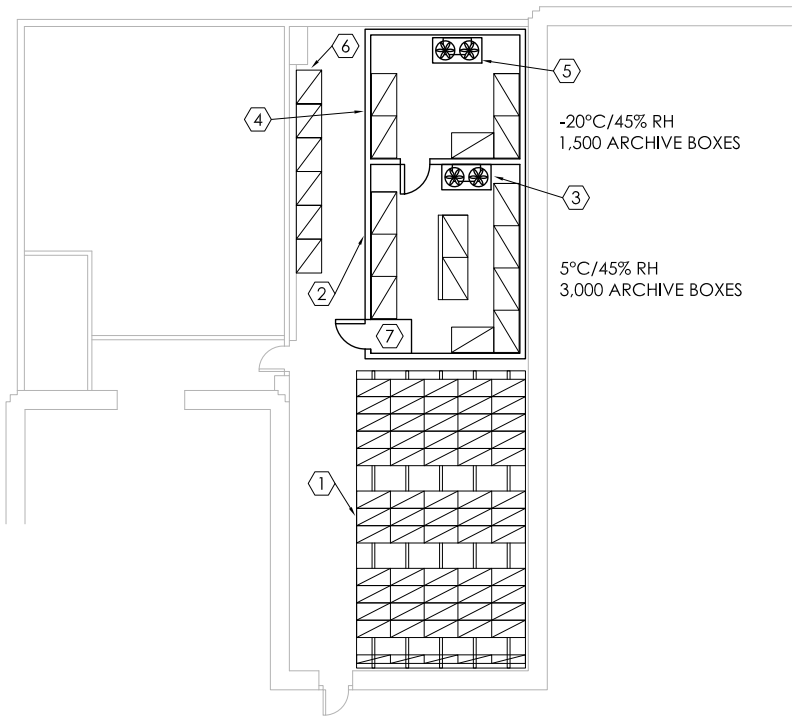
[1] Preservation Index (PI), is an algorithm that estimates the rate of *chemical decay* that would occur in organic materials in given temperature and relative humidity conditions, and is used for comparative analysis of environmental conditions.

- Option 2
  - September-June 65° 30% RH 98 PI
  - June-September 65° 55% RH 49 PI
    - The presence of work benches indicates there is a plan to perform some work inside the spaces. This will add human comfort as a factor when planning and call for warmer conditions.
    - The seasonal RH levels allow for safe drifts in RH that take advantage of the seasonal change. This helps conserve energy by not attempting to produce a year round flat line RH level that will overwork the unit.

- The dew point of Room 328 does not allow for the transition of materials from the refrigerator to the freezer without condensation.
  - Under current average conditions, 73° 31%RH 41° condensation will occur during most of the year if materials are moved from the refrigerator to 328.
  - A container such as a cooler or a plastic bag should be used to contain collection materials and they should be allowed to equilibrate before being removed from the container.

**Options:**

1. Move the door on the freezer to the west wall.
   a. This will allow the movement of materials from the freezer to Room 328 using a cooler or bag to allow the materials to equilibrate.
   b. There is no risk of thermal shock to the photographic materials when moving between the two temperatures.
2. Add an antechamber
   a. The addition of an antechamber between the freezer and the refrigerator, and the refrigerator and the freezer, will eliminate the need to use coolers or bags.
   b. It will also add an additional mechanical system that would need to be maintained.




A2 **GENERAL ARRANGEMENT PLAN**
SCALE: 3/32" = 1'-0"

## GENERAL NOTES

1. STORAGE CAPACITIES ARE BASED UPON A STANDARD ARCHIVE PHOTO BOX WITH THE DIMENSION OF 5¾" WIDE X 4-5/8" HIGH X 10½" DEEP.
2. WALK IN COOLER AND FREEZER SHALL BE A PRE-ENGINEERED PACKAGE ASSEMBLED, TESTED, AND COMMISSIONED BY A FACTORY APPROVED CONTRACTOR.
3. WALK IN COOLER DESIGN CONDITIONS SHALL BE 5° C, 45% RELATIVE HUMIDITY.
4. WALK IN FREEZER DESIGN CONDITIONS SHALL BE -20°C, 45% RELATIVE HUMIDITY.
5. WALK IN COOLER AND FREEZER SHALL HAVE DEDICATED EVAPORATOR AND DEHUMIDIFIER UNITS TO MAINTAIN SPACE CONDITIONS.

## KEYNOTES

1. COMPACT SHELVING SYSTEM. 21,600 ARCHIVE PHOTO BOXES (5¾" WIDE X 4-5/8" HIGH X 10½" DEEP). TOTAL MEDIA WEIGHT 124,200.0 POUNDS. TOTAL FOOTPRINT AREA 815.78 SQUARE FEET. TOTAL WEIGHT 168,524.0 POUNDS.
2. WALK IN COOLER. 5 DEGREES C, 45% RELATIVE HUMIDITY.
3. WALK IN COOLER EVAPORATOR ABOVE, DEHUMIDIFIER BELOW.
4. WALK IN FREEZER. -20 DEGREES C, 45% RELATIVE HUMIDITY.
5. WALK IN FREEZER EVAPORATOR ABOVE, DEHUMIDIFIER BELOW.
6. WORK AREA BENCHES.
7. RAMP INTO WALK IN COOLER. WALK IN COOLER FLOOR IS 12" HIGH.

| No. | REVISIONS/SUBMISSIONS | DATE |
|---|---|---|

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PROJECT TITLE
PROJECT TITLE

GLHN ARCHITECTS & ENGINEERS, INC
2939 E. Broadway Blvd. Tucson, AZ 85716
T 520.881.4044 F 520.795.1822 GLHN.com

| | |
|---|---|
| PROJECT NO. | 1464.10 |
| DESIGN BY: | |
| DRAWN BY: | |
| CHECKED BY: | |
| DATE: | 2015/07/30 |

## Appendix: IPI's Preservation Metrics®

### Natural Aging

**Measures:**

The rate of "natural aging" as determined by the rate of spontaneous chemical change in organic materials.

- TWPI integrates the T and RH values as they change over time into a single estimate of the cumulative effects of the envrionment on the rate of chemical decay.
- TWPI is helpful as a quantitative comparison of the preservation quality of different storage locations or environments.

**Applies to:**

All Organic Materials (paper, textiles, plastics, dyes, leather, fur, etc).

| TWPI Metric | Interpretation |
|---|---|
| TWPI > 75 | GOOD |
| 45 < TWPI ≤ 75 | OK |
| TWPI ≤ 45 | RISK |

### Metal Corrosion

**Measures:**

The effect of the environment on metal corrosion. The % EMC max represents the maximum amount of moisture that was present in hygroscopic collection materials. Because metallic corrosion is dependent on available moisture, the % EMC gives us an idea whether or not metallic objects (mainly ferrous metals) would corrode in such an environment.

**Applies to:**

Metals or materials with metal components.

| Corrosion Metric | Interpretation |
|---|---|
| Max EMC ≤ 7.0 | GOOD |
| 7.1 ≤ Max EMC ≤ 10.5 | OK |
| Max EMC > 10.5 | RISK |

### Mold Risk

**Measures:**

The risk for growth of the xerophilic mold species on collection objects or in collection areas.

**Applies to:**

All organic materials (paper, textiles, plastics, dyes, leather, fur) or inorganic materials with organic films.

| Mold Risk Metric | Interpretation |
|---|---|
| MRF ≤ 0.5 | GOOD |
| MRF > 0.5 | RISK |

**Note:** There is no "OK" rating for mold risk. At a MRF of 0.5, conditions are appropriate for germination of spores. By alerting RISK of mold growth at germination, the user is aware of the potential of mold growth before any visible or vegetative mold will appear. This allows for time to react and prevent formation of vegetative mold.

### Mechanical Damage

**Measures:**

Three aspects of moisture content that promote mechanical or physical damage:

1. Max % EMC: Is it too damp? Will paper curl? Will emulsions soften? Will wood warp?
2. Min % EMC: Is it too dry? Will paper become brittle? Will emulsions crack?
3. % DC: How great are the fluctuations between the most damp and the most dry? Has expansion and contraction - from absorption/de-sorption of water - put physical stress on the collection materials?

**Applies to:**

All organic materials (paper, textiles, plastics, dyes, leather, fur) or inorganic materials with organic films.

| Mechanical Damage Metrics | Interpretation |
|---|---|
| Min EMC ≥ 5%<br>AND Max EMC ≤ 12.5%<br>AND %DC ≤ 0.5% | GOOD |
| Min EMC ≥ 5%<br>AND Max EMC ≤ 12.5%<br>AND 0.5% < %DC ≤ 1.5% | OK |
| Min EMC < 5%<br>OR Max EMC > 12.5%<br>OR %DC > 1.5% | RISK |

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ARIZONA STATE MUSEUM

# The Photography Project:

## NEH Planning Grant Launches Third Major Storage Upgrade at ASM

By Darlene Lizarraga
July 2014

Arizona State Museum is among the beneficiaries of the round of grants from the National Endowment for the Humanities announced July 21, 2014. The $48,962 grant will help conservators and curators consult on and plan for much-needed environmental upgrades for the museum's photographic collection.

*One of five areas now holding the photo collections*
*Photo by Jannelle Weakly*

The ultimate goal is a climate-controlled storage area that will consolidate materials currently stored in five different areas of the museum's north building. Such a facility will create a dynamic educational venue through which the museum can share this incomparable collection with the public as never before. It will be more immediately accessible to students, scholars, members of Native American communities, and the general public.

### About the Collection

ASM's photographic collection is highly valued—just one important and irreplaceable component of the museum's vast holdings, held in trust for the people of the state of Arizona, and among the world's most significant resources for research on, education about, and fostering appreciation of southwestern peoples.

"This is a visual record of the Native peoples and cultures of the southwestern U. S. and northern Mexico," said Teresa Moreno, ASM associate conservator. "No other collection has the same depth and breadth in its coverage of the history of humanity in this region." Moreno and ASM Photo Collections Curator Jannelle Weakly are the project's co-directors and co-authors of the successful grant request.

In total, the collection contains more than 500,000 photographic prints, negatives and transparencies, and more than 250 motion pictures, illustrating the archaeology and ethnology of the region. The collection documents human occupation in the region from ancient times to the present. Individual images range from historic to modern, from documentary to fine art, and includes the work of early 20th century photographers Edward S. Curtis and Forman Hanna.

### About the Project

The NEH grant enables ASM to assemble a top-notch team for this initial planning and design phase of the project. The skills and expertise of specialists from the Image Permanence Institute in

*Acoma woman with olla, by Forman Hanna, 1923. ASM Cat. No. 33553*

Rochester, NY; architects and engineers from GLHN Architects & Engineering, Inc., in Tucson; and professionals from UA's Facilities Management Renovation Services will be enlisted.

This is the third major storage renovation and environmental upgrade project that ASM conservators and curators have embarked on in recent years. The first, the museum's renowned pottery vault completed in 2010, holds more than 20,000 whole vessels, the world's largest and most comprehensive collection of Southwest Indian pottery. The second, completed just this year, is a state-of-the-art visible vault holding more than 25,000 baskets and other items of woven fiber manufacture. It is the world's largest and most comprehensive collection of American Indian basketry. All three projects have been launched with significant federal funding. The first two also benefited from community support, grants from private foundations, and donations from members of the public. Fundraising will commence soon for this project.

### About the Arizona State Museum

Established by the Arizona territorial legislature in 1893, ASM is the oldest and largest anthropology museum in the region, is the nation's largest and busiest state-run archaeological repository, and is an affiliate of the Smithsonian Institution.

ASM occupies two buildings, both on the National Register of Historic Places, within the west-side historic district of the University of Arizona campus. While the buildings' exteriors are beautiful, their interiors and mechanical systems are not up to 21st century museum standards for controlling climate and providing appropriate preservation environments.This project is part of the museum's ongoing effort to retrofit its facilities to better curate its collections.

### About the National Endowment for the Humanities

NEH is an independent federal agency created in 1965. It is one of the largest funders of humanities programs in the United States. The current grants total $34 million to 177 projects. See the NEH media release and the full list of awardees.

### Related Stories

Arizona State Museum's Woven Wonders Nationally Recognized

Improving Preservation for and Increasing Access to ASM's Basketry Collection

Preservation of World's Largest Collection of Southwest Indian Pottery

# Museum grant to save collection of irreplaceable images

AUGUST 23, 2014 10:00 PM • BY TOM BEAL

The $48,962 the Arizona State Museum received recently from the National Endowment for the Humanities won't buy much, but it could go far.

The museum, repository for the state's archaeological and cultural treasures, will use the money to plan for preservation of its photographic collection, as it recently did with its fiber and ceramic treasures.

It can be a long process. The new pottery vault required $2.4 million in grants and contributions. It took seven years to catalog and conserve the pots, and to build 3,200 square feet of climate-controlled vault and display space.

The museum's collection of textiles, from baskets to sandals, is walking a similar path.

They are now ensconced in climate-controlled comfort. An exterior exhibition space has yet to be built.

The museum's photographs, meanwhile, are stored as best they can be in museum-quality sleeves and boxes, but in conditions that speed their gradual deterioration.

The 500,000-plus collection of prints, negatives, slides and film dates to the early 1900s, with some even earlier than that, and spans photo technology from glass plates to digital, said **Janelle Weakly**, curator of the museum's photo collections.

The films and stills document the digs that produced the museum's archaeological finds and the making of its ethnological treasures.

The collection includes glass "lantern slides" used in lectures by some of the museum's famous archaeologists and anthropologists, such as **Emil Haury** and **Byron Cummings**.

Weakly even has a "ballopticon" used to project the images, some of them hand-colored.

The most fragile pieces of the image collection were moved to the only room available to researchers in the pottery vault.

The grant will allow museum conservators to convene a team of architects, facilities managers and image-preservation specialists to plan for a new climate-controlled facility.

**Teresa Moreno**, the museum's associate conservator, said the planning grant could lure additional money from the National Endowment, and further fundraising would be necessary to match it.

Humidity is the biggest threat to the collection, said Weakly. It ranges from 19 percent or so in winter to the 74.2 percent recorded on a muggy morning this week.

The building's air handlers "belong in a museum," joked Moreno.

"It's an actual miracle that some of this technology that dates back to the 1920s still works," said **Patrick Lyons**, the museum's director.

The museum, designed by noted Tucson architect **Roy Place**, was completed in 1926 for use as the University of Arizona library.

It's a great building but it was designed for a very specific purpose — to house the university's book collection in a central stack of metal shelves, five stories high, that also serves as structural support for the building.

A master plan for complete renovation, devised in 2000, had a $60 million price tag.

That's not happening any time soon, so the museum is bringing its facilities up to contemporary snuff in small steps — pots, textiles and now the plan to consolidate an office and two storerooms into a single repository for its photographic images.

Lyons is also making a separate push to remodel the lobby.

He said the acoustics are bad for tour groups, the lighting is not directed toward the exhibits and the exhibits themselves need updating.

His director's council, the museum's fundraising arm, has pledged money for planning and an anonymous donor has promised a substantial gift toward that project.

When all that is accomplished, said Lyons, the museum wants to replace its major exhibit, "Paths of Life," with one that will tell the story of human habitation in the Southwest and how that story is uncovered by archaeologists and anthropologists.

Years of planning have already gone into that exhibit, originally slated for a new exhibition space at the city of Tucson's Rio Nuevo redevelopment site.

Consultation with consultants and tribal representatives have enriched that story, said Lyons, but "it's a different level of fundraising. We've never been in that territory."

He wants to finish the other projects before trying to raise $6-to-$8 million for the new exhibit.

Meanwhile, he's working with the university to confront some "deferred maintenance" on the historic building.

"The university has been a really good partner. They've kicked in air handlers, all sorts of other improvements along the way, whenever they can afford to do it, but the building still has a lot of challenges."

Lyons said he's amazed each change of season when the UA's facilities team manages to coax the building's heating and cooling back into operation, and he wasn't all that surprised when the three-story-high, arched windows that are the building's architectural signature began leaking in recent rains.

azhumanities.org

# Arizona Universities Receive Awards from NEH

*About Post Author Arizona Humanities*


***Arizona State University, Northern Arizona University, and The University of Arizona each receive prestigious grant award from the National Endowment for the Humanities***


Congratulations to the three Arizona universities on their recent grant awards from the National Endowment for the Humanities in July 2014. These impressive, nationally competitive grant awards require an intense application process and support a wide variety of projects.

**Arizona State University: *Nature, History, and Culture at the Nation's Edge***

$60,000

Planning a multiformat interpretation of the cultures, history, and physical landscapes of the Arizona-Sonora borderlands region through a website, a traveling exhibition, and public programs.

**Northern Arizona University: *Exploring Sustainable Practices for Cold Storage for At*-Risk Collections**

$39,971

A planning project to develop recommendations for a dedicated cold storage environment for the university's visual resource collections (photographs, negatives, motion pictures, and magnetic media) documenting the history and culture of the Colorado Plateau region.

**The University of Arizona: *Planning a Sustainable Preservation Environment for Arizona State Museum's Anthropological Photographs***

$48,962

Planning and environmental assessment to create efficient, sustainable plans to repurpose space at the Arizona State Museum (ASM) at the University of Arizona into a consolidated storage space for the museum's collection of photographs documenting the history of Native Americans in the region. The project would identify appropriate and sustainable environmental parameters for the preservation of these photographs in the extreme desert climate of the American Southwest.

**Read more about the NEH Awards**.

# 202_photo_collections_middle

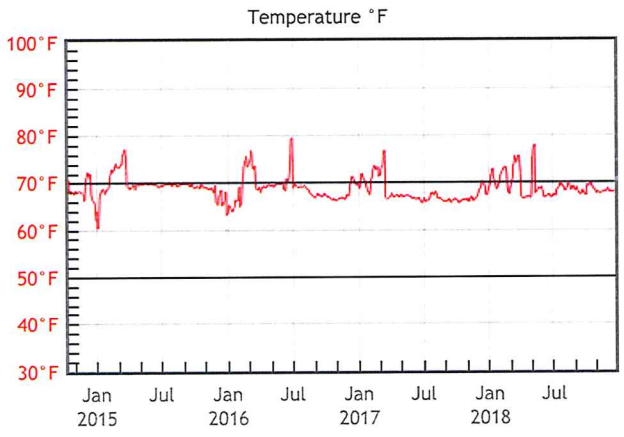
main campus • building 26 • second floor • 202
Arizona State Museum

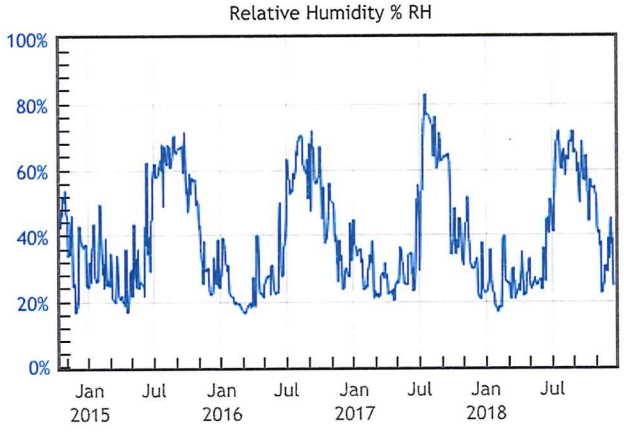
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 50 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 2.91<br>% EMC min = 4.1<br>% EMC max = 14.5 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | RISK<br>MRF = 1.27 | Heightened risk of mold growth due to extended periods of high humidity. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 14.5 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 68.8 | %RH Mean | 39 | DP°F Mean | 41 | T°F < 50 | 0% |
| T°F Median | 68.5 | %RH Median | 34 | DP°F Median | 39.8 | T°F [50,70] | 78.1% |
| T°F Stdev | 2.8 | %RH Stdev | 17 | DP°F Stdev | 10.7 | T°F > 70 | 21.9% |
| T°F Min | 57.3 | %RH Min | 13 | DP°F Min | 15.6 | | |
| T°F Max | 84.9 | %RH Max | 83 | DP°F Max | 61.9 | | |

# 203_photo_collections_east

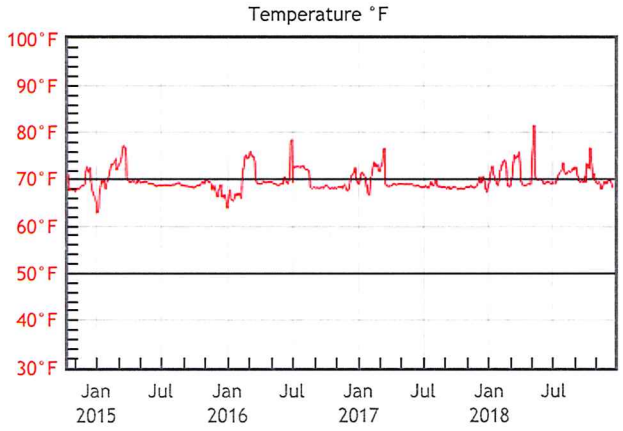
main campus • building 26 • second floor • 203
Arizona State Museum

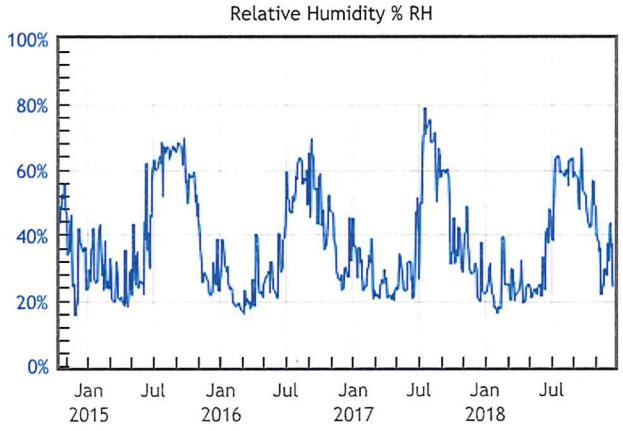
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 50 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 2.6<br>% EMC min = 4.1<br>% EMC max = 13.4 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | RISK<br>MRF = 0.59 | Heightened risk of mold growth due to extended periods of high humidity. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 13.4 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 69.7 | %RH Mean | 38 | DP°F Mean | 40.9 | T°F < 50 | 0% |
| T°F Median | 69 | %RH Median | 34 | DP°F Median | 39.8 | T°F [50,70] | 71.9% |
| T°F Stdev | 2.4 | %RH Stdev | 16 | DP°F Stdev | 10.7 | T°F > 70 | 28.1% |
| T°F Min | 60 | %RH Min | 13 | DP°F Min | 16.2 | | |
| T°F Max | 83.3 | %RH Max | 79 | DP°F Max | 62.1 | | |

# 204_photo_collections_west

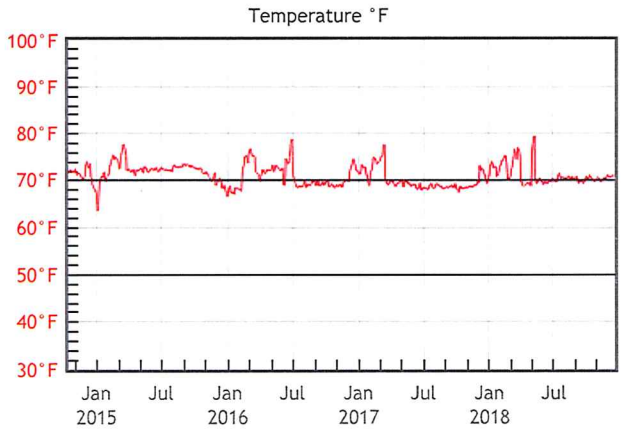
main campus • building 26 • second floor • 204
Arizona State Museum

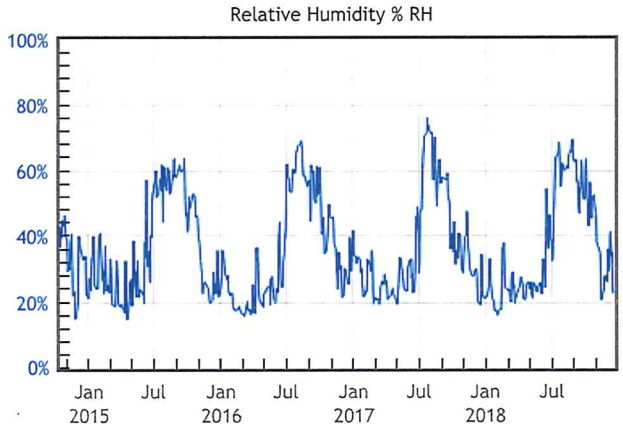
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 48 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 2.59<br>% EMC min = 3.9<br>% EMC max = 13.1 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | GOOD<br>MRF = 0.41 | Minimal risk of mold growth. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 13.1 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 71 | %RH Mean | 36 | DP°F Mean | 40.8 | T°F < 50 | 0% |
| T°F Median | 70.7 | %RH Median | 32 | DP°F Median | 39.5 | T°F [50,70] | 40.5% |
| T°F Stdev | 2.4 | %RH Stdev | 15 | DP°F Stdev | 10.6 | T°F > 70 | 59.5% |
| T°F Min | 62.6 | %RH Min | 12 | DP°F Min | 16 | | |
| T°F Max | 83.3 | %RH Max | 76 | DP°F Max | 61.6 | | |

# 206_photography_studio

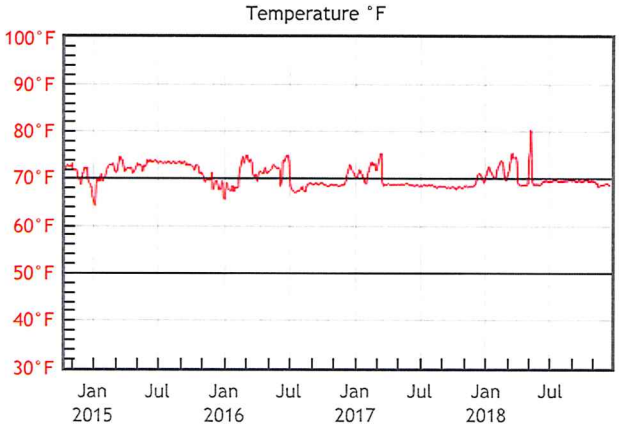
main campus • building 26 • second floor • 206
Arizona State Museum

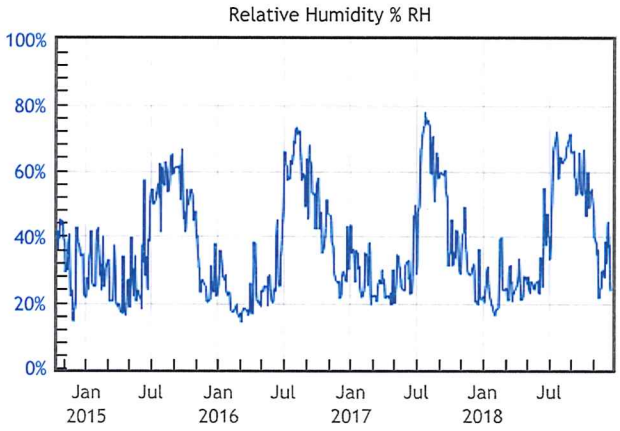
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 48 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 2.72<br>% EMC min = 3.9<br>% EMC max = 13.6 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | RISK<br>MRF = 0.84 | Heightened risk of mold growth due to extended periods of high humidity. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 13.6 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 70.4 | %RH Mean | 37 | DP°F Mean | 41.1 | T°F < 50 | 0% |
| T°F Median | 69.6 | %RH Median | 33 | DP°F Median | 39.8 | T°F [50,70] | 55.6% |
| T°F Stdev | 2.2 | %RH Stdev | 16 | DP°F Stdev | 10.9 | T°F > 70 | 44.4% |
| T°F Min | 62.9 | %RH Min | 11 | DP°F Min | 15.3 | | |
| T°F Max | 80.4 | %RH Max | 78 | DP°F Max | 62.6 | | |

# 123A_pottery_vault_research

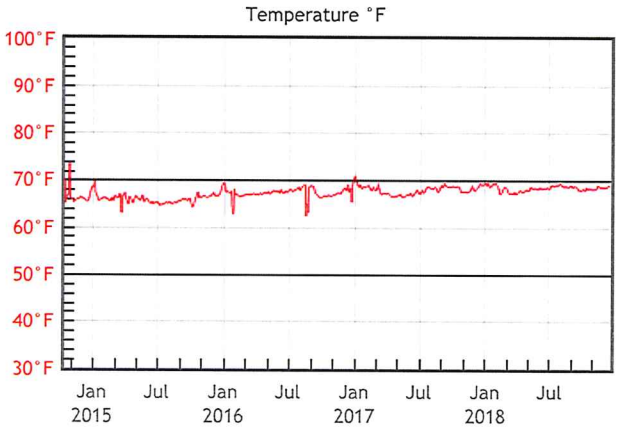
main campus • building 26 • first floor • 123
Arizona State Museum

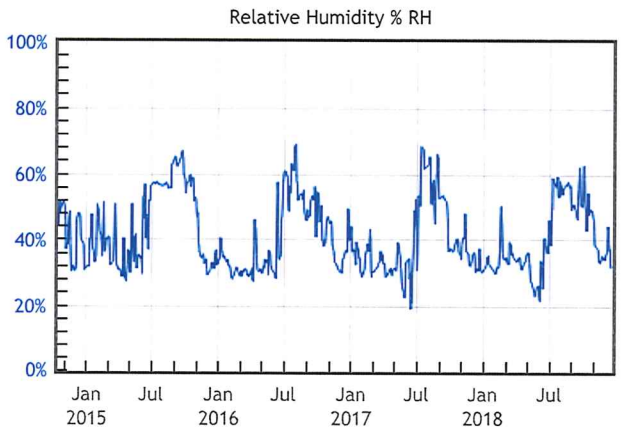
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 55 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 1.8<br>% EMC min = 5.4<br>% EMC max = 11.8 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | GOOD<br>MRF = 0.08 | Minimal risk of mold growth. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 11.8 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 67.5 | %RH Mean | 41 | DP°F Mean | 42.4 | T°F < 50 | 0% |
| T°F Median | 67.6 | %RH Median | 38 | DP°F Median | 40.9 | T°F [50,70] | 98.2% |
| T°F Stdev | 1.5 | %RH Stdev | 11 | DP°F Stdev | 6.8 | T°F > 70 | 1.8% |
| T°F Min | 59.1 | %RH Min | 19 | DP°F Min | 22.7 | | |
| T°F Max | 74.4 | %RH Max | 75 | DP°F Max | 62.2 | | |

# 125_conservation_lab

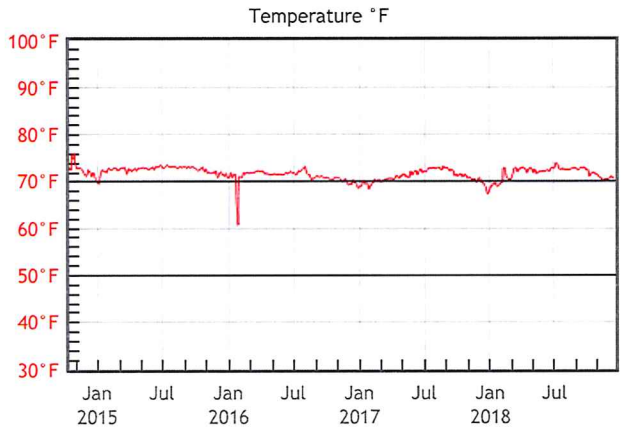
main campus • building 26 • first floor • 125
Arizona State Museum

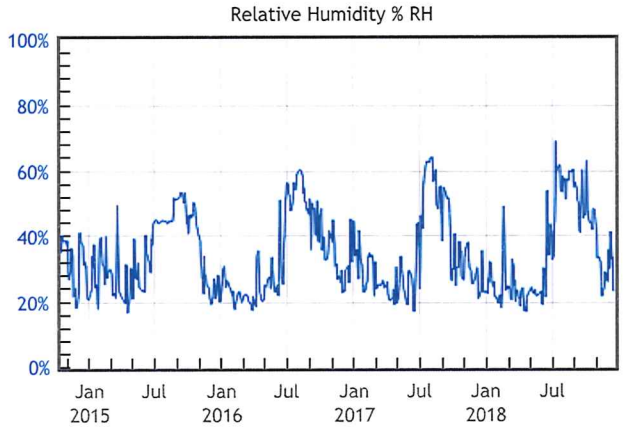
2014-10-14 to 2018-12-20
4 years, 2 months, 7 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 48 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 1.81<br>% EMC min = 4.6<br>% EMC max = 11.1 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | GOOD<br>MRF = 0 | Minimal risk of mold growth. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 11.1 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 71.6 | %RH Mean | 34 | DP°F Mean | 40.6 | T°F < 50 | 0% |
| T°F Median | 71.7 | %RH Median | 31 | DP°F Median | 39.2 | T°F [50,70] | 12.5% |
| T°F Stdev | 1.5 | %RH Stdev | 13 | DP°F Stdev | 9.7 | T°F > 70 | 87.5% |
| T°F Min | 60.6 | %RH Min | 14 | DP°F Min | 20 | | |
| T°F Max | 79.5 | %RH Max | 69 | DP°F Max | 63.6 | | |

# 103B_dark_room

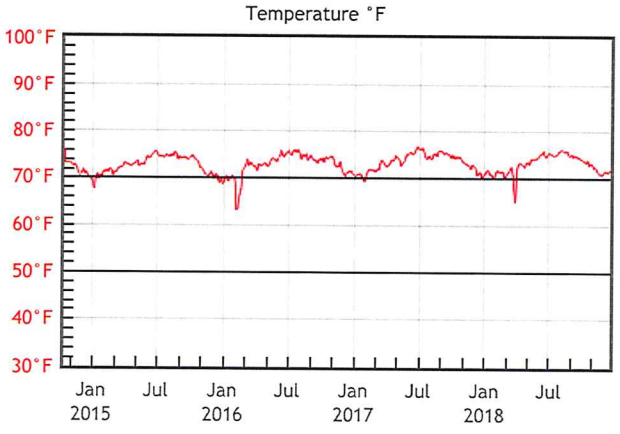
main campus • Building 30 • Basement • 103B
Arizona State Museum

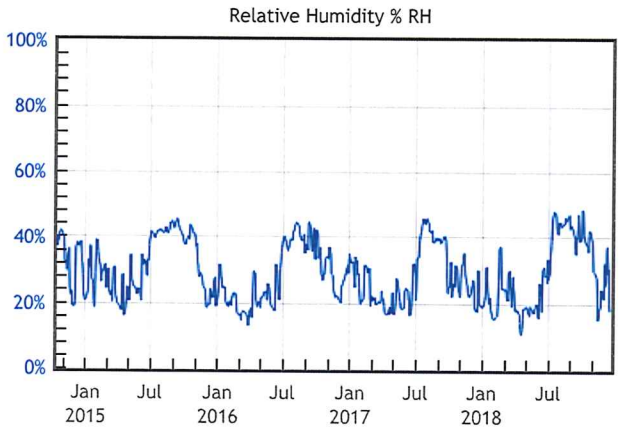
2014-10-14 to 2018-12-20
4 years, 2 months, 7 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 51 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 1.25<br>% EMC min = 3.9<br>% EMC max = 8.4 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | GOOD<br>MRF = 0 | Minimal risk of mold growth. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | OK<br>% EMC max = 8.4 | Generally OK, but archeological or salt-encrusted metals may corrode due to extended periods of moderately high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 73 | %RH Mean | 30 | DP°F Mean | 38.1 | T°F < 50 | 0% |
| T°F Median | 73.2 | %RH Median | 28 | DP°F Median | 37.7 | T°F [50,70] | 6.9% |
| T°F Stdev | 2.1 | %RH Stdev | 9 | DP°F Stdev | 9.3 | T°F > 70 | 93.1% |
| T°F Min | 61.8 | %RH Min | 10 | DP°F Min | 12.9 | | |
| T°F Max | 77.3 | %RH Max | 53 | DP°F Max | 55.9 | | |

# 328_collections_storage

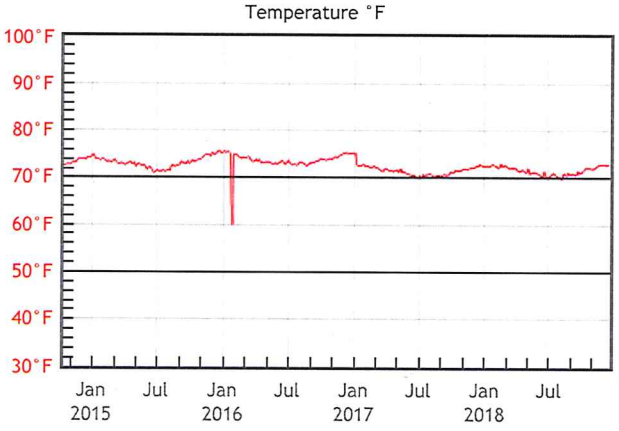
main campus • building 26 • third floor • 328
Arizona State Museum

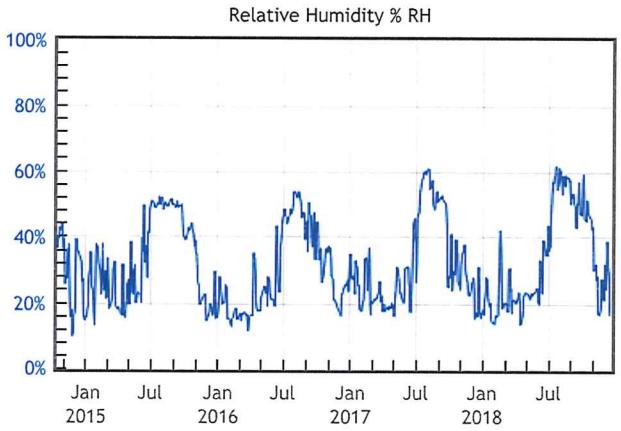
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 49 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 1.92<br>% EMC min = 3.7<br>% EMC max = 10.6 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | GOOD<br>MRF = 0 | Minimal risk of mold growth. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 10.6 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 72.5 | %RH Mean | 32 | DP°F Mean | 39 | T°F < 50 | 0% |
| T°F Median | 72.6 | %RH Median | 29 | DP°F Median | 38.6 | T°F [50,70] | 3% |
| T°F Stdev | 1.5 | %RH Stdev | 13 | DP°F Stdev | 10.5 | T°F > 70 | 97% |
| T°F Min | 59.9 | %RH Min | 10 | DP°F Min | 13.5 | | |
| T°F Max | 78 | %RH Max | 73 | DP°F Max | 63.4 | | |

# 328_mezzanine_storage

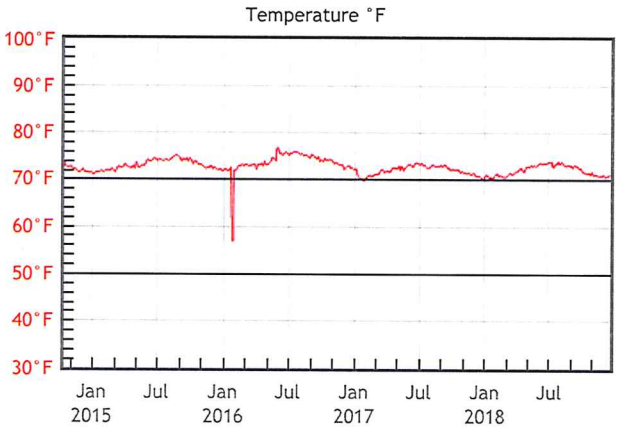
main campus • building 26 • third floor • 328
Arizona State Museum

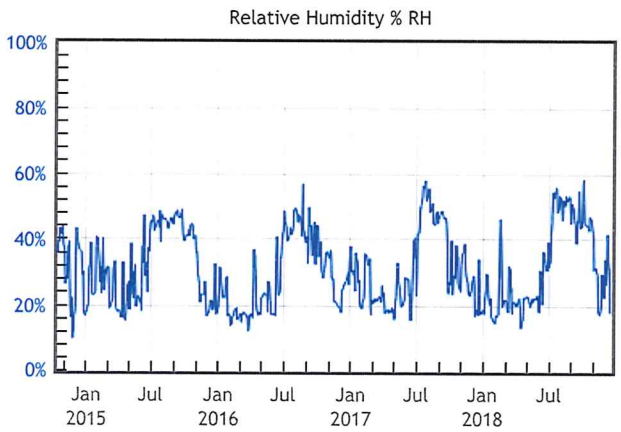
2014-10-13 to 2018-12-20
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | OK<br>TWPI = 49 | Generally OK, but fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics will be at elevated risk due to the cumulative effects of temperature and humidity |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 1.61<br>% EMC min = 3.9<br>% EMC max = 9.7 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | GOOD<br>MRF = 0 | Minimal risk of mold growth. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | OK<br>% EMC max = 9.7 | Generally OK, but archeological or salt-encrusted metals may corrode due to extended periods of moderately high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 72.7 | %RH Mean | 31 | DP°F Mean | 38.9 | T°F < 50 | 0% |
| T°F Median | 72.6 | %RH Median | 29 | DP°F Median | 38.5 | T°F [50,70] | 2.6% |
| T°F Stdev | 1.7 | %RH Stdev | 12 | DP°F Stdev | 10.4 | T°F > 70 | 97.4% |
| T°F Min | 56.8 | %RH Min | 10 | DP°F Min | 12.2 | | |
| T°F Max | 77.9 | %RH Max | 72 | DP°F Max | 63.6 | | |

# TUCSON,AZ

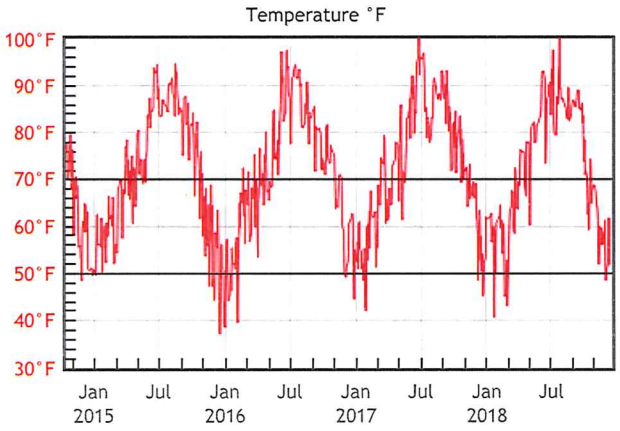
outdoors • outdoors • outdoors • outdoors
Arizona State Museum

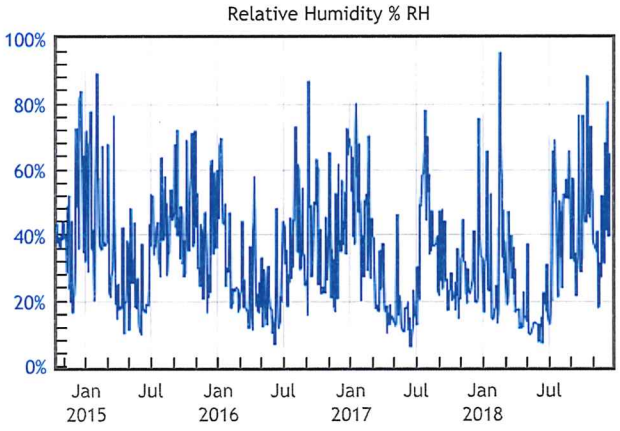
2014-10-12 to 2018-12-19
4 years, 2 months, 8 days

## Preservation Environment Evaluation

| Type of Decay | Risks & Metrics | Evaluation & General Comments |
|---|---|---|
| **Natural Aging**<br>Chemical decay of organic materials | RISK<br>TWPI = 36 | Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics. |
| **Mechanical Damage**<br>Physical damage to hygroscopic materials | RISK<br>% DC = 2.42<br>% EMC min = 2.8<br>% EMC max = 11.5 | Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation. |
| **Mold Risk**<br>Mold growth in area or on collection objects | RISK<br>MRF = 1.89 | Heightened risk of mold growth due to extended periods of high humidity. |
| **Metal Corrosion**<br>Corrosion of metal components or objects | RISK<br>% EMC max = 11.5 | Heightened risk of metal corrosion due to extended periods of high levels of humidity. |

## Graphs




## Statistics

| Temperature | | Relative Humidity | | Dew Point | | T Limits | |
|---|---|---|---|---|---|---|---|
| T°F Mean | 72.6 | %RH Mean | 33 | DP°F Mean | 41 | T°F < 50 | 8.7% |
| T°F Median | 73.4 | %RH Median | 28 | DP°F Median | 34.2 | T°F [50,70] | 34.9% |
| T°F Stdev | 16.1 | %RH Stdev | 21 | DP°F Stdev | 16.5 | T°F > 70 | 56.4% |
| T°F Min | 23 | %RH Min | 1 | DP°F Min | -17 | | |
| T°F Max | 115 | %RH Max | 100 | DP°F Max | 73.2 | | |